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LEPIGRE (A. L.). **La désinsectisation par fumigation avec vide préalable.**—*Docum. phytosanit. Minist. Agric. Fr.* sér. ent. no. 9, xii+318 pp., 70 figs. (1 fldg.), 49 refs. Algiers, the Author, 1949. Price 2,500 *frs.*

This handbook on the commercial control of insect pests by means of vacuum fumigation has four main chapters. The first deals with general principles and includes discussions of the advantages and disadvantages of fumigation at atmospheric and reduced pressure and of the available methods of producing a vacuum, the effects of reduced pressure on insects, the factors affecting the efficiency of vacuum fumigation, the properties required in fumigants employed for this purpose, the mode of action of those commonly used, and the risks attending the incomplete removal of fumigant absorbed by the treated commodities. The second chapter contains details of the installations and equipment required for commercial and experimental fumigation stations and mobile fumigation units and of their maintenance, and the third is concerned with the general arrangement of commercial fumigation stations. The fourth comprises schedules for the treatment of various classes of commodities. Other sections deal briefly with precautions to prevent reinfestation of treated products, and the development of commercial vacuum fumigation, chiefly in France and Algeria. An appendix based on the author's previous work [*R.A.E.*, A **36** 297] contains information on the chemical and physical properties of methyl bromide, ethylene oxide and hydrocyanic acid gas, their action on the commodities treated with them, and their toxicity to man.

WEIGEL (C. A.) & BAUMHOFER (L. G.). **Handbook on Insect Enemies of Flowers and Shrubs.**—*Misc. Publ. U.S. Dep. Agric.* no. 626, iii+115 pp., 170 figs. Washington, D.C., 1948. Price 35 *cts.* (from Supt. Documents).

The bulk of this handbook comprises concise notes on the appearance and, in some cases, life-history of some 200 insects and mites that attack ornamental plants in gardens in the United States, the damage they cause, and methods of controlling them. So far as possible they are arranged according to their food-plants. A final section is concerned with the preparation and use of standard insecticides and with spraying and dusting equipment suitable for their application in gardens, DDT being the subject of a brief appendix.

RUSSELL (L. M.). **The North American Species of Whiteflies of the Genus** *Trialeurodes*.—*Misc. Publ. U.S. Dep. Agric.* no. 635, 85 pp., 34 figs., 23 refs. Washington, D.C., 1948. Price 25 *cts.* (from Supt. Documents).

This revision of the North American species of *Trialeurodes* includes descriptions of the genus and the 34 species recognised from that region, 13 of which are new, with records of the food-plants and distribution of the species, and a key to the pupae. It is considered that *T. mossopi*, Corb. [*R.A.E.*, A **23** 103, 690], *T. natalensis*, Corb. [**30** 403] and *T. sonchi*, Kot. [**10** 285] are synonyms of *T. vaporariorum*, Westw., and that *T. caricae*, Corb. [**24** 635] is a synonym of *T. variabilis*, Quaint. New combinations include *T. corollis*, Penny, and *T. diminutis*, Penny, both of which were described in *Asterochiton* [**10** 445].

WOGLUM (R. S.) & LEWIS (H. C.). **Leaf Roller attacks** *Citrus* **Trees.**—*Calif. Citrogr.* **32** no. 7 pp. 308–309, 4 figs. Los Angeles, Calif., 1947.

A small but serious outbreak of *Tortrix* (*Archips*) *argyrospila*, Wlk., that developed during late March 1947 on *Citrus* in southern Tulare County, California, would have destroyed the entire flush of spring growth, including the flowers in some groves, if control measures had not been taken. On *Citrus*, egg-masses containing 50–100 eggs are deposited on the grey wood of the larger branches. The larvae, which began to hatch about 15th March in 1947, feed on the young spring growth during late March and early April, roll or fold the leaves with their webs and pupate in late April in rolled leaves on the trees. The adults emerge and oviposit in early May. There is only one generation a year. Dusting with 2 per cent. DDT in sulphur on navel oranges and with 5 per cent. DDT in talc on Valencias at the rate of 100 lb. per acre in late March gave very satisfactory control, most of the larvae leaving their shelters before they died. It was undesirable to apply sulphur to Valencias bearing mature fruit because of the irritation it causes to pickers.

MOYANO (A.), RENNER (M. J.) & BORSANI (L. F.). **Lucha contra las cochinillas mediante el empleo de aceites lubricantes usados.** [Control of Coccids by Means of used lubricating Oils.]—*Experimenta* **2** nos. 1–3 pp. 54–61, 3 refs. Mendoza, 1949. (With Summaries in English, Italian, French and German.)

In view of the high cost of commercial winter oils, investigations were made at Mendoza, Argentina, to find whether an effective oil-emulsion spray could be prepared from used motor oil, which is available in large quantities. The oil has to be purified before use to free it from carbon and other foreign matter, and decanting for 7–8 days followed by filtering was found satisfactory. Of the emulsifiers tested, the best consisted of fatty acids and commercial ammonia. A stock emulsion was prepared from the used motor oil, diesel oil, fatty acids, commercial ammonia and water (8 : 1 : 2 : 1 : 3 by volume) and dispersed in water at 4–8 per cent. The dilute sprays were applied in October 1948 at a temperature of 20·5°C. [68·9°F.] to olive trees infested with *Aspidiotus hederae*, Vall., *Chrysomphalus paulistus*, Hemp., and *Parlatoria oleae*, Colv. They proved as effective as commercial winter oils, 6–7 per cent. concentrations giving the best results ; 8 per cent. caused some injury to the leaves, though no leaf-drop occurred. The emulsions broke rapidly after application and scale coverage was excellent.

FOX (C. J.), STIRRETT (G. M.), ARNOTT (D. A.) & WRESSELL (H. B.). **The chemical Control of the Tomato Hornworm on Tobacco in Ontario.**—*Sci. Agric.* **29** no. 12 pp. 553–562, 8 refs. Ottawa, 1949.

Prior to the recent war, sprays of acid lead arsenate were used as a routine measure against *Protoparce quinquemaculata*, Haw., on tobacco in Ontario. They gave better control than the alternative cultural measures recommended, which comprised autumn ploughing, destroying the larvae in the curing barns and on second-growth tobacco and trapping the adults, but were undesirable on account of the poisonous residues, and comparative tests of other insecticides were accordingly made during 1938–40 and again in 1947–48. In spray tests in 1938, synthetic cryolite, applied at 13 lb. per acre on 26th July, was more effective against the larvae than barium fluosilicate at the same rate or calcium arsenate at 6 lb. per acre, but much less effective than lead arsenate at 13 lb. per acre. In 1939, lead arsenate at 3·5 lb. per acre was better than cryolite at 8 lb., though both gave commercial control of leaf damage, but cryolite at 6 lb. was less effective and a fixed nicotine (nicotine-bentonite) was of no value. From further work in 1940, it was concluded that cryolite should be applied at not less than 18 lb. per acre for good leaf protection. In a comparison of sprays and dusts, a dust of lead arsenate at 17 lb. per acre gave nearly as good results as a spray of cryolite at 22 lb. per acre, which was the best treatment tested on that occasion ; dusts of cryolite did not remain effective for so long as dusts or sprays of lead arsenate or sprays of cryolite.

The effect of early and late sprays of lead arsenate (applied when five eggs or larvae were seen per 100 plants and 1–2 weeks later, respectively) was studied in 1939 and 1940. In 1939, an early application of lead arsenate at 18·5 lb. per acre on 14th July was as effective against the larvae as one on that date followed by another on 26th July, and one application at the same rate on 26th July was almost as effective as two, each at 7·4 lb. per acre, on 14th and 26th July ; all gave commercial control, as also did an early, but not a late, application alone at the reduced rate. In 1940, the greatest reduction in leaf damage was given by two applications of lead arsenate at 12 lb. per acre, but when cost and toxic residues were also considered, the most satisfactory treatments were found to be a single early application at 12 lb. per acre and an early and a late application each at 5 lb.

In 1947, more recently developed insecticides were tested. Sprays were applied on 8th August, and the percentages for control of the larvae a week later, as compared with no treatment, were 99·7, 99·1 and 98·8 for 1·3, 2·2 and 0·72 lb. DDT per acre in a wettable powder, 95·9 and 95·1 for 4·7 and 2·2 lb. lead arsenate, 79 for 2·5 lb. *Ryania*, and 90·8 and 32·8 for 1·5 and 0·65 lb. chlordan, respectively ; benzene hexachloride, tested at a much lower rate, was disappointing. In 1948, single applications of dusts containing 3 and 5 per cent. DDT on 22nd July at 30 lb. per acre gave averages of 70·5 and 72·5 per cent. control for the season, which were commercially adequate, but 3·2 per cent. lead arsenate was of no value. DDT dusts also proved satisfactory when used in the field by growers. No leaf injury due to the insecticides was observed in any of the tests. It was considered that DDT would probably replace other materials for the control of *Protoparce* on tobacco.

RISBEC (J.). **I. La faune entomologique des cultures au Sénégal et au Soudan français. II. Contribution à l'étude des Proctotrupidae.**—*Trav. Lab. Ent. Sect. soudan. Rech. agron.* no. 1–2, 638 [+1] pp., 4 pls., 288 figs., many refs. [Dakar] Gouvt. gén. A.O.F., 1950.

In the first part (pp. 1–500), the author lists the insect pests that attack crop plants in Senegal and the French Sudan and gives descriptions and notes on the bionomics, control and natural enemies of the majority. The insects, most of which are figured, are arranged systematically according to the plants they attack, and general pests and pests of stored seeds are dealt with separately. Other sections contain information on predators, parasites and hyperparasites, an account of the factors affecting the abundance of insects and a review of the methods and materials by means of which they can be controlled.

In the second part (pp. 511–638), he gives descriptions, with localities, and where possible, host records of some 120 Proctotrupoidea, including 70 new species and several new varieties, and three Mymarids, all of which are new ; the descriptions of five of the Proctotrupoids, including three new ones, are given in an appendix, which also contains additional localities for a few of the others. The work is based on specimens reared or collected in Senegal or in the collection of the Museum National d'Histoire Naturelle. The Mymarids are from French West Africa, and of the Proctotrupoids, most are from French West Africa, French Equatorial Africa or Kenya, but some are from Madagascar or neighbouring islands and eight from other parts of the world. Keys are given to the African or Ethiopian genera and species, and a list showing the geographical distribution of most of the species dealt with and a table showing the hosts of about half of them are appended.

JANNONE (G.). **Contributi alla sperimentazione sulla lotta antiacridica in Eritrea dal 1942 al 1946. II. La lotta nelle aree coltivate o coperte da fitta vegetazione mediante " Gammexane " approntato e distribuito col metodo " Bredo."** [Contributions to Experiments on Locust Control in Eritrea from 1942 to 1946. II. Control in Cultivated Areas or those covered with dense Vegetation by Means of Gammexane prepared and distributed by Bredo's Method.]—*Risvegl. agric.* 1947 no. 21–22 repr. 7 pp., 4 figs. Taranto, 1947.

In this second part of a series [*cf. R.A.E.*, A **38** 141], the author reviews the established methods of controlling bands of hoppers and swarms of adult locusts on cultivated land or dense vegetation, with special reference to *Schistocerca gregaria*, Forsk., in Eritrea, quotes from a circular by O. B. Lean describing Bredo's method of applying suspensions of benzene hexachloride against them by means of brooms [**36** 294], and gives a brief account of a test in which this method was tried against first- and second-instar hoppers of *S. gregaria* in a field of sorghum in Eritrea in August 1946. Sorghum flour was added to the suspension. The hoppers began to die three hours after treatment, and all were dead or dying after 20 hours. There was no opportunity for a large-scale test, but it was feared that the method would not be sufficiently rapid in its results to afford much protection to mature grain attacked by adult locusts, though many of these might be killed.

CLARK (L. R.). **Behaviour of Swarm Hoppers of the Australian Plague Locust *Chortoicetes terminifera* (Walker).**—*Bull. Commonw. sci. industr. Res. Org. Aust.* no. 245, 27 pp., 1 fig., 15 refs. Melbourne, 1949.

The following is largely the author's summary. Field observations in 1946 on hoppers of *Chortoicetes terminifera*, Wlk., produced from swarm layings in flat or undulating country bearing a variety of vegetation types near Trangie in the Bogan-Macquarie outbreak area of New South Wales [*cf. R.A.E.*, A **38** 45] showed that they exhibit, at first, no apparent differences in behaviour from those of non-swarming populations of low density [**37** 219]. Band formation and mass migration did not occur for a fortnight after hatching. The daily behaviour régime of these hoppers resembled that of non-swarming individuals in many ways. Temperature played a major part in determining the distribution of young hoppers during the first ten days after hatching. Field experiments, using thermometers with blackened bulbs, indicated the existence of a temperature preferendum for first-instar hoppers within the range 38–45°C. [100·4–113·0°F.]. The mean of these temperatures is approximately 42°C. [107·6°F.], a value similar to the preferendum previously determined for non-swarming adults [**37** 219]. Hoppers in the first and second instar deserted their basking places when the temperatures therein rose above about 45°C. and sought cooler situations. Below this temperature, hoppers accumulated in the warmest available places. After the onset of mass migration, temperature continued to exert a marked influence. Winds stronger than light breezes appeared to assist in the formation of aggregates of hoppers, which accumulated and basked in situations sheltered from them, but these situations were also the warmest, and it was not possible to determine whether this behaviour was a response to temperature or to wind pressure. The direction of marching hoppers was not affected by that of the wind ; strong gusts caused them to stop, and less strong gusts sometimes initiated outbursts of activity among resting locusts. The hoppers appeared to be attracted to dense masses of other hoppers, and once in them, moved in response to their movements.

The change from individualistic to gregarious behaviour was effected by a period of crowding, the necessary length of which varied in relation to population density and, probably, temperature. Dense populations began mass migration in the second instar, but less dense ones (about 40–50 per sq. yard at hatching) did not begin until the fourth or fifth instar. After the beginning of mass migration, the excitability and hence mutual responsiveness of hoppers continued to increase. In areas of low plant cover containing plenty of green food, large numbers of hoppers concentrated at the front of the bands, but where there was little food, the hoppers formed long streams with marked differences in density throughout. The daily initial direction of march of bands of the first type was determined by the forward movement of the relatively scattered hoppers behind the dense front, to which they are attracted, and did not usually vary from day to day. In bands of the second type, each of the contained masses was stimulated as a result of the movement of other hoppers towards them, and the initial direction depended on that from which most hoppers were attracted. These bands frequently changed direction on successive days and sometimes broke up into smaller ones. Gregariousness is also responsible for maintaining the direction of march, the only other influences of importance being obstacles such as water, fallen or standing trees, stands of dense pasture, and areas of shade, which may cause all or parts of a band to change direction. Some evidence was obtained of a weak orientation to the position of the sun, but it played only a minor part, if any, in maintaining direction. The major factors influencing the rate of march were temperature, band density and the nature of the plant cover through which hoppers were passing. Temperature influenced excitability, and hence mutual responsiveness. The amount of mutual stimulation, and therefore movement, also depended on the density of hoppers in a band. The maximum distance moved by any band from hatching to the flying state was 1¾ miles. The maximum observed rate of migration was 7 ft. per minute. The distances moved daily by bands ranged from a few feet to almost a quarter of a mile, depending on the factors already noted and on the age, and hence size, of the hoppers.

BRIMBLECOMBE (A. R.) & CANNON (R. C.). **The Protection of stored Potatoes against the Potato Tuber Moth,** *Gnorimoschema operculella* **Zell. Part 1.—Trials in southern Queensland. Part 2.—Trials in northern Queensland.**—*Qd J. agric. Sci.* **6** no. 2 pp. 77–86, 1 ref. Brisbane, 1949.

In the first part of this paper Brimblecombe gives an account of experiments in southern Queensland in 1943–44 in which derris dust gave outstanding protection of stored potato tubers against *Gnorimoschema operculella*, Zell. The results have been noticed from a less detailed source [*R.A.E.*, A **35** 241].

In the second part, which is by Cannon, a description is given of similar trials in 1946 and 1947 in northern Queensland where satisfactory control over a period of five months had been obtained in 1945 by dusting the tubers with magnesite at the time of harvesting [*cf. loc. cit.*]. In 1946, uninfested and uninjured tubers harvested on 10th October were dusted on 1st November with derris dust (1 per cent. rotenone), magnesite and ferric oxide at a rate of 16 lb. per ton and stored in bags. Twelve weeks later, losses due to *Gnorimoschema* among the tubers treated with the three dusts amounted to 0·55, 2·4 and 6·75 per cent., respectively, and exceeded 50 per cent. among untreated tubers ; no further losses occurred among treated tubers during the next fortnight [**36** 249]. A slight increase in infestation that had occurred among treated tubers after nine weeks is attributed to the appearance of a second generation of larvae, produced by moths that developed from those that had penetrated the tubers before treatment. Ferric oxide was rather more effective against these larvae than magnesite.

In 1947, tubers that had received the usual field grading were treated at 8 lb. per ton on 23rd September with dusts containing 1 per cent. rotenone as derris, 2 per cent. p,p′ DDT in pyrophyllite or magnesite alone, and were subsequently stored in bags for 21 weeks, during which they were examined six times. At the end of 15 weeks, percentage losses due to *Gnorimoschema* were 2·07, 1·63 and 1·3, respectively, among treated tubers, and 3·5 among untreated ones, and no further losses occurred. It is concluded that the regular discarding of decayed and decaying tubers at each examination completely eliminated the source of infestation. There was no significant difference in the control given by the different treatments. Since residues of DDT remaining after cooking are reported to be small [**36** 74], it may safely be used on tubers for consumption as well as on those for seed.

Balcells Rocamora (E.). **Estudio bioclimatológico de *Plagiodera versicolora* Laich. (Col. Chrisomelidae).** [A bioclimatological Study of *P. versicolora*.]—*Publ. Inst. Biol. apl.* **3** (1946) pp. 57–77, 8 figs., 51 refs. Barcelona, 1947. (With Summaries in German and English.)

The author records incomplete observations on the development of larvae of *Plagiodera versicolora*, Laich., collected on poplar in Catalonia and discusses from the world literature the distribution of this Chrysomelid and the effect of climatic factors on its life-cycle and development [*cf. R.A.E.*, A **5** 238 ; **21** 263 ; **29** 439]. It infests species of poplar and willow, occurs in Europe, Asia and the United States [*cf.* also **36** 104] and has several varieties.

The following is based on the conclusions from the study. *P. versicolora* is a pest in all countries between 52 and 30°N. lat. that are included between the annual isotherms for 9 and 12°C. [48·2 and 53·6°F.] and have a normal continental or maritime climate. Its possible limits of distribution are the annual isotherms for 18 and 6°C. [64·4 and 42·8°F.]. The most favourable zones lie between the January isotherms for —3 and 5°C. [26·6 and 41°F.] and the July isotherms for 20 and 26°C. [68 and 78·8°F.]. Excessive humidity in subtropical countries and lack of it in semi-desert regions cause a summer diapause, which limits the spread of the insect to the south. There are undoubtedly four generations a year in northern Spain, where conditions are very favourable, but a summer diapause occurs in the southern half, owing to high temperatures or drought. The cessation of activity at the onset of hibernation in autumn and its resumption in spring are apparently related to effective hours of sunshine.

Aldama Herrero (R.) & Camps Mestre (J. M.). **Acción de *Ctenolepisma lineata* sobre los tejidos de seda artificial.** [The Action of *C. lineata* on Rayon Fibres.]—*Publ. Inst. Biol. apl.* **3** (1946) pp. 113–118, 1 fig. Barcelona, 1947. (With Summaries in English and German.)

Following reports of damage by insects to rayon in factories and stores in the district of Barcelona, the authors examined damaged material and found remains of *Ctenolepisma lineata*, F., and *Anthrenus museorum*, L. In laboratory tests with examples of these two insects, *C. lineata* attacked rayon fabric, causing typical holes in it, but *A. museorum* fed only on dead examples of its own species, causing no damage to the cloth. In further tests, rayon impregnated by a method leaving an adsorbed layer of an insoluble sodium arsenostannate, which is resistant to washing and toxic to insects, was not attacked by *Ctenolepisma* and the insects died, whereas untreated fabric was severely damaged. Difficulties arose in the commercial application of the process, as inequalities in deposit interfered with even dyeing, but it proved satisfactory for fabrics that were not to be dyed. Equally good results were obtained by impregnation with arsenates and fluorides in the finishing liquid, and this method proved satisfactory for goods that were not likely to be subjected to much washing. Analysis showed the minimum effective rates per sq. metre to be about 0·25 gm. arsenic and 4–5 gm. sodium fluoride.

LOMBARDI (P. L.). **L'azione del DDT sugli allevamenti del baco da seta.** [The Effect of DDT on Silkworm Rearing.]—*Ann. Sper. agrar.* (N.S.) **1** no. 2 pp. 359–368. Rome, 1947. (With a Summary in English.)

In April 1947, the author observed that considerable mortality of silkworms [*Bombyx mori*, L.] was caused in Calabria, a great silk-producing area, by the sprays of 5 per cent. DDT in kerosene applied in houses against the mosquito vectors of malaria. The damage was greatest when the temperature was moderate or low, the weather cloudy or wet, the rooms in the houses small and poorly ventilated and the village streets narrow. Silkworms were killed not only by contact with the insecticide, but also when kept in rooms that had been treated several days previously or in rooms in a house other than those treated.

In special experiments, complete mortality ensued when silkworms in various instars were introduced into rooms that had been sprayed with the kerosene solution up to six days previously. After 10–15 days, mortality was much less and it was apparent that young silkworms were more susceptible than older ones, many of which recovered after showing symptoms of poisoning. Further tests showed that there was little danger of poisoning 15 days after treatment and that spraying with kerosene alone caused hardly any losses. A solution of 60 parts DDT in 40 parts xylene, emulsified in eight times its volume of water, was as toxic as the kerosene solution soon after it was applied, but lost its effect on the silkworms 8–10 days after application. Eggs were not affected by house spraying. When eggs, silkworms, cocoons and adults were placed on paper or cardboard sprayed up to three months previously, only the silkworms, including those that hatched from the eggs, were affected. Adults left for over an hour on the sprayed surfaces remained on them motionless, behaved normally soon after being removed and showed no loss of fertility.

It is concluded that spraying against mosquitos should be carried out a month before the beginning of the silkworm season, that is to say, in February in southern Italy and before 10th April in the rest of that country.

JANNONE (G.). **Alimentazione e danni delle cetonielle.** [The Mode of Feeding of Cetoniids and the Damage due to them.]—*Agricoltura pugliese* **1** nos. 10–12 repr. 12 pp., 7 figs., 14 refs. Bari, 1947.

In the spring or early summer of 1947, the author observed injury to the young fruits of almond and peach, the stems of lupin, the ears of wheat and the flowers and young fruits of sweet and mandarin oranges in a district of Apulia by adults of the Cetoniids, *Oxythyrea funesta*, Poda, *Tropinota squalida*, Scop., and *Epicometis* (*T.*) *hirta*, Poda. He reviews the Italian literature on the feeding habits of these beetles, from which it appears that they have usually been regarded as feeding mainly on the organs of flowers and as having mandibles not well adapted to chewing, most of the injury due to them being caused by the spines on their legs. On the young almonds, however, they eroded the surface and in some cases penetrated to the kernels, up to six attacking a single fruit. Severely injured fruits dropped from the trees, but lightly damaged ones healed over and were often still usable. The damage was undoubtedly due to chewing. The young peaches were similarly injured. The lupins were growing between almond trees, and the cortical tissue on the upper parts of the stems and branches was eroded, causing the parts above the injury to die. Some thousands of plants were completely destroyed in this way. The wheat was damaged not only during flowering, but also after it, during the period of milky ripeness. The beetles penetrated the glumes and fed on the starchy parts of the grains. Control by hand collection had to be organised, but the beetles migrated to other plants before much damage was done to the crop. Similar injury was reported from Salerno. On orange, the beetles not only destroyed the male flowers in their search for pollen, but also damaged the young fruits and the peduncles. Some trees were protected by covering them with strong muslin, but the crop on those not so covered was almost wholly destroyed.

MÜNSTER (J.). **Recherches sur les pucerons de la pomme de terre. La fréquence en Suisse romande des pucerons vecteurs de maladies à virus.**—*Mitt. schweiz. ent. Ges.* **21** pt. 1 pp. 159–179, 2 figs., 15 graphs, 16 refs. Berne, 1948.

The only method so far adopted in Switzerland for ascertaining the suitability of a district for the production of virus-free seed potatoes has been the actual growing of samples. This has not given entirely comparable results, and investigations were therefore begun in French Switzerland in 1945 on the value for this purpose of counts of the Aphid population per 100 leaves by a modification of Davies' technique [*cf. R.A.E.*, A **22** 386]. The counts were made in six localities in the Cantons of Vaud, Fribourg and Valais in 1945, 1946 and 1947 and the results compared with the percentages of virus infection, estimated from samples of tubers grown in the following year. The results are shown in tables and graphs, and the weather in the three seasons is described. It was not normal in any of the three years, being unusually warm in 1945 and 1947, and very unfavourable for Aphid increase in 1946. The main species observed were *Myzus persicae*, Sulz., *Aphis* (*Doralis*) *rhamni*, Boy., and *Macrosiphum solanifolii*, Ashm. (*gei*, auct.). The population usually began to increase in May or June and usually reached its peak in July or August, but in 1947 it continued to increase in September in several localities. In 1945, the percentages of virus infection ranged up to 98, but were relatively low (about 50) in two of the localities. *A. rhamni* was the commonest species in both, while *Myzus persicae* was absent from one and did not become numerous until early August in the other. In 1946, *M. persicae* predominated generally, but the Aphid populations were very small and virus infection was only 1–11 per cent. In 1947, populations reached very high figures (40,000–50,000 per 100 leaves in one place), and *M. persicae* again predominated. Virus infection ranged up to 24 per cent. in five of the localities and reached 88 in the sixth, though the Aphid counts were lower there than in some of the others. The increase is attributed to early infestation by *M. persicae*.

Definite conclusions are not drawn from the work, but it is considered that the method has value and should be extended to all seed-producing areas. The date for harvesting seed potatoes is provisionally fixed at two, or at most three, weeks after the Aphid counts have reached 80–100 per 100 leaves, and it is considered that areas in which it reaches 100 by the end of June or the beginning of July are definitely unsuitable for production, since the harvesting date would be too early to permit an adequate crop. The best areas would be those in which this figure is not reached before mid-July.

MONTE (O.). **Combate às "paquinhas" das hortas.** [The Control of Mole-crickets in Kitchen Gardens.]—*Biológico* **13** no. 10 pp. 165–170, 1 fig. São Paulo, 1947.

In view of complaints of damage to various vegetable crops in gardens in São Paulo by *Gryllotalpa hexadactyla*, Perty, the habits of this mole-cricket are described and methods of controlling it reviewed from the literature [*cf. R.A.E.*, A **32** 297; **34** 191].

SEIXAS (C. A.). **Luta contra os gafanhotos.** [The Control of Locusts.]—*Biológico* **13** no. 11 pp. 190–195. São Paulo, 1947.

Swarms of the South American migratory locust (*Schistocerca cancellata*, Serv.) reach the State of São Paulo only about once in 15 years and last did so at the end of 1946. The way in which control measures were organised is described and their effectiveness discussed. The adult locusts caused little damage, since they had migrated far and had long reached sexual maturity, and the swarms had become broken up into scattered agglomerations. Attempts were made to destroy swarms resting at night by means of flame-throwers and an insecticidal spray, but the results were disappointing. Hoeing and ploughing destroyed many of the eggs, but as the egg stage lasted only 17 days, these measures could be used only on ground that did not require clearing. Spraying with kerosene emulsion prepared cold with soap was effective against the hoppers less than a fortnight old, which move about but little, while flame-throwers and poison baits gave excellent control of older hoppers. The baits chiefly used contained 1 part arsenic trioxide or Paris green in 30 and 40 parts rice bran, respectively, and were moistened with one-third of their volume of water at the site of application. In some cases, salt was added, as it keeps the bait moist owing to its hygroscopic qualities and thus prolongs its attractiveness.

AUTUORI (M.). **Combate à formiga saúva.** [The Control of Leaf-cutting Ants.]—*Biológico* **13** no. 11 pp. 196–199, 6 figs. São Paulo, 1947.

The difficulty of controlling leaf-cutting ants [chiefly species of *Atta*] by means of fumigants in the field in São Paulo, despite their susceptibility in the laboratory, is largely due to the fact that there is no direct means of access to the fungus beds, which are the vital centres in the nests. The advantage of the tool devised there for the application of liquid fumigants [*cf. R.A.E.*, A **29** 40 ; **35** 108] is that it penetrates directly to the fungus beds. The way in which it is used is described.

OTAMENDI (J. C.). **Las hormigas podadoras del Brasil. Informe sobre una gira de estudio.** [The Leaf-cutting Ants of Brazil. Report on a Study Tour.]—[*Publ.*] *Inst. Sanid. veg.* (B) **3** no. 10, 46 [+2] pp., 39 figs. Buenos Aires, 1947.

The author visited Brazil in late 1945 to study and report on the methods used in that country for the control of leaf-cutting ants of the genera *Atta* and *Acromyrmex* and the organisation of control campaigns. He gives detailed descriptions of the methods and apparatus used [*cf. R.A.E.*, A **30** 424 ; **31** 479 ; **35** 108 ; etc.] and also of the way in which the ants are reared in artificial chambers in the laboratory [**32** 107], with some of the results obtained.

GRIOT (M.) & ICART (A.). **Observaciones sobre *Allocota bruchi* Brèthes, parásito del "bicho de cesto."** [Observations on *Phobetes bruchi*, a Parasite of *Oiketicus kirbyi*.]—[*Publ.*] *Inst. Sanid. veg.* (A) **3** no. 31, 12 pp., 12 figs., 5 refs. Buenos Aires, 1947.

The Ichneumonid parasites of *Oiketicus kirbyi*, Guild., in Argentina successively described by Brèthes in the same paper as *Allocota bruchi* and *Phobetes bruchi* [*cf.* also *R.A.E.*, A **5** 506 ; **13** 200] have been shown to be the female and male, respectively, of the same species. The authors use the name *Allocota* for the genus to which it belongs [but *Allocota*, Foerst., is preoccupied in Coleoptera by *Allocota*, Motsch., and *Phobetes* appears to be the next available name for it].

The immature stages of *P. bruchi* are described. Examination of samples of *O. kirbyi* from various parts of Argentina showed that it was parasitised by this Ichneumonid in the Provinces of Buenos Aires, Córdoba, Entre Ríos, Santa Fe and San Juan and in La Pampa. The percentage parasitism was usually 1–2, but varied locally up to 18.

In laboratory investigations on the bionomics of the parasite, the adults paired soon after emergence and survived for 20 days when kept in warm conditions and given wild flowers and a mixture of sugar, honey and agar as food. Dissected females contained about 50 eggs each. The female stung the Psychid larva through the bag enclosing it and laid an egg on or near it ; the larva sometimes attempted to escape through the exit of the bag but was ultimately overcome by paralysis. Unfertilised females gave rise to males only. The larvae feed externally and pupate in cocoons. The egg, larval and pupal stages lasted 2–3, 8–12 and 10–12 days, respectively, and there were three generations and a partial fourth between December and February. The winter is passed by the full-fed larvae in their cocoons. Some adults emerged in November from field-collected material brought to the laboratory, but their progeny were unable to complete their development, since the larvae of *O. kirbyi* were at that time too small to provide sufficient food. Parasites that hatched in December did not suffer in this way. Overwintering larvae of *P. bruchi* were parasitised by *Tetrastichus pseudoeceticola*, Blanch. [*cf.* **34** 300].

FREIBERG (M. A.). **La oruga de la alfalfa,** *Colias lesbia* **(Fabricius) (Lep. Pier.) en la Argentina.** [The Lucerne Caterpillar, *C. lesbia*, in Argentina.]—[*Publ.*] *Inst. Sanid. veg.* (A) **3** no. 36, 27 [+1] pp., 17 figs., 1 map, 29 refs. Buenos Aires, 1947.

Colias lesbia, F., is the most harmful insect pest of lucerne in Argentina and destroys about a quarter of the annual crop. Numerous subspecies, aberrations and forms of it have been described there and some 18 names proposed for them. The author has reared the butterfly from many parts of Argentina, from Salta in the north to Chubut in the south, and concludes that the only valid one of these is a colour form of the female (*heliceoides*, Capronnier), all the others being merely seasonal variations. All stages of *C. lesbia* are described, including summer and winter forms. It has three generations a year in the south and develops without interruption in the Chaco. Under favourable conditions, the egg, larval and pupal stages lasted 2–4, 13–20 and 4–7 days, respectively [*cf. R.A.E.*, A **12** 224], but all were prolonged by cold. The preoviposition period lasted 1–3 days, and the greatest number of eggs laid per female was 236, in seven days. To lay so many, a female has to be fertilised several times, and the males are usually less long-lived than the females. The butterflies have been observed to migrate long distances, and this is responsible for the annual appearance of *C. lesbia* in Patagonia, where it cannot survive the winter cold. A list is given of its natural enemies ; they do not seem to be of importance in its control.

DOMATO (J.) & ARAMAYO (H.). **Contribución al estudio de las moscas de las frutas en Tucumán.** [A Contribution to the Study of Fruit-flies in Tucumán.]—*Bol. Estac. exp. agríc. Tucumán* no. 60, 27 pp., 5 col. pls., 2 figs. Tucumán, 1947.

Ceratitis capitata, Wied., was observed in the Province of Tucumán, Argentina, for the first time in March 1945, and its appearance there has complicated the problem of the loss of *Citrus* fruits caused by fruit-flies, of which the most important hitherto have been *Anastrepha* spp. Experiments showed that it completed its development from egg to adult in 38 days, whereas *A. fraterculus*, Wied., required 50 days under the same conditions. As a preliminary to investigations on its distribution in the Province by means of bait-traps, the attractiveness to it of 16 different baits was tested at the Experiment Station [*cf. R.A.E.*, A **30** 458]. The most effective was a 25 per cent. solution of molasses, while 50 per cent. ground kumquats in water and undiluted orange juice were the next best. Grapefruit juice alone or diluted was fairly effective, and rather better than wine vinegar or beer. All these attracted both sexes of *C. capitata* and *Anastrepha* spp., but kerosene attracted males of *C. capitata* only. Further tests showed that fermentation increased the attractiveness of molasses and that the concentration could safely be reduced to 15 per cent. Traps were then exposed in seven localities in the Province, chiefly on *Citrus* trees. The work was begun in November 1946, and as *C. capitata* was caught in all localities but one, it is thought to occur throughout the *Citrus*-growing region. It appeared earlier in some districts than in others.

As it was feared that the fruit-fly might have become established in the mountains, where a profuse growth of trees and shrubs would afford it a constant succession of host-fruits and permit the formation of permanent breeding areas, the observations were extended to two such districts in January 1947. Fruits were collected in one of them, but though various fruit-flies were reared from these, including *A. peruviana*, Tns., which had not previously been known from the region, *C. capitata* was not among them, and it was not taken in bait-traps in either district. Details of the survey are shown in tables.

In experiments on control, orange, grapefruit and guava trees were sprayed with DDT. The results were conflicting, but it was evident that applications for the prevention of fruit-fly infestation should be begun in February, before the adult flies appear in numbers. During February and March (the end of the wet season), sprays should be applied every 20 days, but from then onwards, the interval can be increased to 25–30 days. It is thought that DDT could well be added to the oil emulsion applied against Coccids to *Citrus* trees, thus affording a combined treatment and permitting a reduction in the concentration of the oil.

In laboratory tests with three proprietary preparations of DDT, unsatisfactory results were given by enclosing fruit-flies with sprayed twigs and fruits, as some flies did not come into contact with the sprayed surfaces. More reliable results were obtained when the whole interior of the cage was sprayed and the fruit-flies introduced soon after. All three preparations at the various rates tested gave complete mortality by this method within periods that ranged from 9 to 32 hours.

Anastrepha spp. have several parasites in Tucumán, of which one of the most important is *Eucoila pelleranoi*, Brèthes, and it is common to dispose of infested fruits in pits covered with a lid of perforated zinc, to permit the adult parasites, but not the fruit-flies, to escape. As *C. capitata* is smaller than *Anastrepha*, the diameter of the perforations should be reduced to 1·25–1·5 mm. The pits so far used have usually been 6–7 ft. deep, but it has been found that the weight of the fruit when they are full causes rapid fermentation to set in, which kills many of the parasites, so that only those from the top layers emerge. A depth of 3½ ft. is therefore recommended. As an instance of the value of the biological control afforded, it is recorded that of 5,900 fruit-fly puparia from guava that were kept under observation in 1947, 1,650 gave rise to *Anastrepha*, 60 to *C. capitata*, 565 to *E. pelleranoi* and 120 to other parasites, while no emergence occurred from the others. Disregarding these, it is calculated that the percentage parasitism by *Eucoila* was 23·6 and that by all parasites 28·6.

FREIBERG (M. A.). **Una nueva especie de** *Dysdercus* **(Hemipt. Pyrroc.) "chinche tintórea" del algodonero.** [A new Species of *Dysdercus*, a Cotton-staining Bug.]—*Physis* **20** pp. 121–123, 1 fig. Buenos Aires, 1948.

The author consulted Costa Lima as to the identity of the two species of *Dysdercus* on cotton in Argentina dealt with in his previous paper [*R.A.E.*, A **36** 142] and now concludes that the one there referred to as *D. pallidus*, Blöte, is a new species, which he here describes from the adults of both sexes as *D. chaquensis*, sp. n., and that the other is *D. mendesi*, Blöte.

LAMAS C. (J. M.). **Comportamiento de las principales plagas del algodonero en los valles de Huaura, Supe y Pativilca en las campañas de 1944–45 y 1945–46.** [The Behaviour of the principal Pests of Cotton in the Valleys of Huaura, Supe and Pativilca in the Seasons of 1944–45 and 1945–46.]—*Inf. Estac. exp. agríc. La Molina* no. 65, 36 pp., 24 graphs. Lima, 1947.

Observations on the pests of cotton in the valleys of Huaura, Supe and Pativilca, Peru [*cf. R.A.E.*, A **35** 76] were continued in the seasons of 1944–45 and 1945–46. Losses due to *Dysdercus ruficollis*, L., were serious in the first year, but much less so in the second, when parasitism by *Acaulona peruviana*, Tns., and *Paraphorantha peruviana*, Tns., was somewhat higher, 34 per cent. of the adults being parasitised by them in one part of Huaura. Infestation by *Anomis texana*, Ril., developed normally in both seasons, reaching its maximum in February. The larvae were well controlled by arsenicals and by natural enemies, *Blondelia* (*Eucelatoria*) *australis*, Tns., parasitising 60 per cent. of them in one part of Huaura in 1944–45. *Aphis gossypii*, Glov., was of little importance, largely owing to control by natural enemies. Early infestation by *Anthonomus vestitus*, Boh., was favoured by the presence of cotton plants in the fields between crops, and fairly heavy damage resulted in the second year. *Heliothis virescens*, F., and *Mescinia peruella*, Schaus, caused little injury. Other pests of little or no importance recorded in both years included *Pyroderces rileyi*, Wlsm., thrips, *Empoasca* spp., *Pinnaspis* (*Hemichionaspis*) *minor*, Mask., *Bucculatrix thurberiella*, Busck, *Platynota* sp. and *Tetranychus* sp.

WOLCOTT (G. N.). **What has happened to the Giant Surinam Toad** *Bufo marinus* **L., in Puerto Rico.**—*Rev. Agric. P. Rico* **38** no. 1 pp. 25–29, 7 figs. San Juan, P.R., 1948.

The introduced toad, *Bufo marinus*, appears to have become scarce in Porto Rico of recent years, probably in part because it had reduced the number of insects and other small animals on which it feeds. These include adults of Lamellicorns [*cf. R.A.E.*, A **22** 155] and of the Elaterid, *Pyrophorus luminosus*, Ill. [*cf.* **25** 441], the larvae of which are predacious on Lamellicorn larvae, and the millepede, *Trigoniulus lumbricinus*, Gerst.; all these have recently reappeared in coastal areas from which the toad had practically eliminated them, and Lamellicorn larvae, notably *Cnemarachis* (*Lachnosterna*) *portoricensis*, Smyth, caused serious injury in sugar-cane fields in the spring of 1946.

Another factor leading to a decrease in the numbers of the toad is destruction of tadpoles by birds and dragonfly larvae, and also by larvae of the Dytiscid, *Megadytes giganteus*, Lap., which are voracious and attack the tadpoles as the latter are almost ready to leave the water. For some years after *B. marinus* became established in Porto Rico, growers used to collect the toads from the Guanica and Cartagena lagoons, in the south-west of the island, and liberate them in cane-fields. Owing to the drought in the spring of 1946 and the drying up of the lagoons, this supply has now ceased and no other such ready source is available. It may become necessary to breed the toad in artificial protected pools [*cf.* **29** 7].

Ullyett (G. C.). **Distribution of Progeny by** *Cryptus inornatus* **Pratt (Hymenoptera : Ichneumonidae).**—*Canad. Ent.* **81** (1949) no. 12 pp. 285–299 ; **82** no. 1 pp. 1–11, 13 figs., 12 refs. Guelph, Ont., 1950.

The author's investigations on host finding and oviposition by insect parasites [*cf. R.A.E.*, A **37** 56 ; **38** 160] were continued with *Cryptus inornatus*, Pratt, an Ichneumonid that parasitises the larvae of *Loxostege sticticalis*, L., in Canada and has been introduced into South Africa and liberated there against *Loxostege frustralis*, Zell., on *Pentzia* spp. in the Karroo [*cf.* **21** 148]. It is pointed out that such studies facilitate the mass rearing of a parasite in the laboratory. The larvae of *L. sticticalis* are attacked in their cocoons, which are constructed just below the surface of the soil round the base of the food-plant and become partly exposed as a result of weathering of the soil. The female parasite first paralyses the larva and then oviposits on it. The parasite larva feeds externally on its host, which it eventually destroys, and later constructs its cocoon within that of its host. Only one parasite can complete its development on each host. *C. inornatus* is most abundant in the autumn, when it attacks the overwintering second-generation larvae of *L. sticticalis*. The results of the work are given in detail and discussed with reference to those obtained with the two parasites previously studied. Cocoons of *L. sticticalis* that had been formed in sandy soil were used, since they were attacked more readily than the tougher ones formed in clay soils. The temperature was 75°F. and the relative humidity 65 per cent.

In the first series of experiments, the cocoons were exposed to the parasite females in small wooden cages ($3\frac{1}{4}\times2\frac{1}{2}\times3\frac{1}{4}$ ins.) with muslin backs, thick celluloid fronts and ventilation holes covered with muslin. When there were 2–25 cocoons in each, and a single mated parasite female was introduced and left for 24 hours, the total number of hosts found and paralysed increased with increasing host density, but the proportions that were paralysed and used for oviposition both declined, the latter at first rapidly and then more gradually. When two females were confined for 24 hours with 20 hosts, which was the optimum number for the experimental area, they paralysed about the same number as two confined for 48 hours, but oviposited on less than half as many and deposited less than half as many eggs. Dissection showed that about four eggs reach or almost reach maturity in each female per day and that all the mature eggs present each day are laid. In consequence of the need to oviposit when mature eggs are present, superparasitism occurs at low host densities. Except when the number of available hosts was below the minimum daily requirement of the females, the latter showed a strong tendency to deposit only one egg on each. The mean number of eggs per host exceeded one at all densities, however, and the efficiency of the female in depositing eggs to the best advantage appeared to be about 80 per cent., either because the discriminative ability was imperfectly developed or, more probably, because of failure to find and oviposit in paralysed hosts.

When 20 host cocoons were exposed for 24 hours to 2–20 parasites, the number of hosts paralysed and the percentage of paralysed hosts that were used for oviposition both increased with parasite density, though the number of hosts paralysed and the number used for oviposition by individual females declined rapidly. A sudden increase in the parasite population to which a given host population within a given area is exposed does not therefore lead to a corresponding increase in parasitism, partly because the ovipositing females impede one another, and partly because the total number of eggs laid in 24 hours increases directly with parasite density and leads to superparasitism. A sudden increase in host population can be utilised immediately, however, and the efficiency with which the eggs are distributed depends mainly on the number of hosts available.

In further tests the area of the environment was made 15 times as great, and the numbers of hosts and parasites kept constant. This did not materially affect the numbers of hosts attacked, eggs laid, and eggs deposited per host, or the ratio of eggs to attacked hosts, but slightly fewer hosts were parasitised in the larger area and the percentage on which only one egg was deposited was considerably lower. These results showed that when the same number of hosts is distributed over a wider space, the parasite exerts a greater effort to cover it and find the requisite number of hosts, though superparasitism is more likely to occur.

It is concluded that in *C. inornatus*, the ability to distinguish between suitable and unsuitable hosts is the fundamental factor influencing the distribution of progeny, but that it can be overcome by the physiological need to deposit mature eggs. Since the number of eggs that mature daily is very small, the absolute number of hosts present does not have any marked influence on their distribution except when it is also very small. Of the two factors involved in alterations in the ratio between populations of hosts and parasites, mutual interference resulting from an increase in the number of ovipositing females is usually of greater importance than the reduction in the proportion of hosts.

MATTHEWMAN (W. G.), RATHWELL (A. W.) & LACHAINE (J. P.). **Notes on the Species of Root Maggots damaging Onions, Cabbage, and Radish at Ottawa in 1948.**—*Canad. Ent.* **82** no. 1 pp. 12–16, 1 ref. Guelph, Ont., 1950.

Observations by A. R. Brooks in 1947 indicated that the Dipterous larvae associated with the roots of garden crops in Canada usually comprise a complex of species, that the species represented and their proportions vary with season and locality, and that as many as 15 occur at the roots of cabbage and 14 at those of onions ; some of these species are directly responsible for injury, while others play a secondary part, so that an involved succession may result. Further collections were accordingly made at Ottawa in 1948. The 1,493 larvae collected from wilting and dying onion plants at approximately weekly intervals during the period of attack (4th June to 21st July) comprised 1,451 of *Hylemyia antiqua*, Mg., 19 of *H. cilicrura*, Rond., 14 of saprophytic Phorids, 5 of *Eumerus* (*Paragopsis*) *strigatus*, Fall., 3 of *Muscina assimilis*, Fall., and 1 of a predacious species of *Platypalpus*. All of 40 larvae collected from stored onion bulbs on 2nd October were *E. strigatus*. It is therefore concluded that *H. antiqua* is primarily responsible for wilting and death, and that *E. strigatus*, which was not collected earlier than 14th July, may cause much of the late-season infestation. Cabbages transplanted on 18th May were pulled and examined at weekly intervals from early June until late July. Infestation was very light ; none of the plants examined on the last three dates was infested and there was practically no mortality. The 119 larvae collected comprised 112 of *H. brassicae*, Bch., 3 of *H. cilicrura*, 3 of *H. trichodactyla*, Rond., and 1 of a predacious species of *Platypalpus*. Larvae were also collected from radish plants that were about one month old and had been sown between 11th May and 14th June. Infestation was light, and only 98 larvae were found, of which 90 were *H. brassicae*, 5 *H. cilicrura*, and 3 *H. trichodactyla*.

BELLEMARE (E. R.) & BRUNELLE (L.). **Larval and pupal Development of** *Dermestes maculatus* **Degeer under controlled Conditions of Temperature and Relative Humidity.**—*Canad. Ent.* **82** no. 1 pp. 22–24, 4 refs. Guelph, Ont., 1950.

In laboratory experiments on the development of *Dermestes maculatus*, Deg., newly hatched larvae placed individually in tubes with dehydrated dog food (Purina chow) to feed on and pupae formed less than an hour previously were kept at constant temperatures of 25, 28, 31 or 34°C. [77, 82·4, 87·8 or 93·2°F.] and relative humidities of 0, 20, 50, 70 or 100 per cent. The larvae completed their development only at 70 and 100 per cent. relative humidity. Most of those kept at the lower humidities moulted, but development was arrested during the second instar. At 70 per cent. relative humidity, the number of instars averaged eight at 25°C. and seven at the other temperatures, a few larvae moulting 11–12 times, while at 100 per cent. it averaged five in all cases. The average duration of the larval stage at 70 and 100 per cent. humidity ranged from 4·2 and 2·4 days, respectively, at 34°C. to 5·8 and 3·9 at 25°C. Relative humidity had no effect on the duration of the pupal stage, which averaged 5 days at 34°C. and 8·5 days at 25°C.

MAXWELL (C. W. B.). **Field Observations on the Black Army Cutworm,** *Actebia fennica* **(Tausch.), and its Control on Blueberries in New Brunswick.**—*Sci. Agric.* **30** no. 3 pp. 132–135, 1 ref. Ottawa, 1950.

In 1944 and 1945, *Actebia* (*Agrotis*) *fennica*, Tauscher, caused serious damage to cultivated blueberries in parts of New Brunswick, where it had not previously proved injurious, and in Maine. The overwintered larvae emerge from the soil in early spring and feed at night, preferring the buds and open blossoms to the foliage. During the day, they shelter in the ash and decaying vegetable matter on the soil surface. Very small larvae are occasionally found in buds, and it is thought that these may have hatched from overwintered eggs, though no eggs have been seen. The larvae pupate in the soil in early June, and the adults emerge in late July or early August. In both years, nearly all the damage was on areas in their first year of fruit production after being burnt over [*cf. R.A.E.*, A **16** 89], areas in their second or third year of production being hardly infested at all. The females apparently lay their eggs in areas burned over in the early spring of the same year.

In 1944, infestation was first reported on 24th May on blueberries in full bloom, and all the blossoms were destroyed on many areas together with the green foliage. The larvae began to migrate when most of the foliage had been eaten but pupated on 28th to 29th May. It was observed in 1945 that infestation was more or less evenly distributed on areas that had at one time been cultivated, whereas on rough areas it was largely confined to hummocks and knolls, though the whole area was attacked if populations were large. The mean temperature and the rainfall for May were well above and somewhat below their respective averages in 1944 and equal to and much above them in 1945. Under these conditions the plants produced heavy bloom before infestation occurred in 1944, whereas both plant and insect development were retarded in 1945 and the buds were destroyed before much bloom was produced.

Attempts to estimate the distribution and frequency of the larvae in the spring of 1945, before much damage had occurred, showed that the best results were given by sweeping at night with a heavy sweeping bag. It was found that control measures were required when the number per 50 sweeps exceeded 25, and that economic losses should not occur when it was less than 15. In experiments on control in 1945, dusts were applied to heavily infested plots on various dates in May. Few or no larvae were swept from those dusted with

3 per cent. DDT, but 2 per cent. Lethane [a thiocyanate preparation], a mixture of copper sulphate, calcium arsenate and hydrated lime (20 : 20 : 60), and synthetic cryolite alone or in gypsum (30 : 70) gave no apparent control. Larvae found showing symptoms of poisoning in débris on the plots dusted with DDT died within 24 hours. A bait of 20 lb. bran, 1 lb. Paris green and 2 quarts molasses or oil gave no control, even at rates of up to 150 lb. per acre.

Wilson (C. C.). **Control of the Devastating Grasshopper in California.**—*Bull. Dep. Agric. Calif.* **36** no. 3 pp. 97–102, 3 figs. Sacramento, Calif., 1947.

Melanoplus mexicanus devastator, Scud., is abundant on semi-arid range land throughout California at elevations from near sea level to 5,000 ft. The eggs, which are deposited on protected slopes, hillocks, ridges and the sides of ravines, begin to hatch about 10 days later than do those of other grasshoppers in the same area. The hatching period lasts 50–103 days, occurring between late April and early August. Adults appear from late May or early June, but do not pair or oviposit until the onset of cool autumn weather with rains sufficient to germinate the seeds of annual plants. Oviposition usually occurs from September to mid-October, but may be delayed by prolonged drought until mid-December [*cf. R.A.E.*, A **29** 222]. In late summer, the adults congregate on patches of late-maturing weeds and use the latter as protection against the high soil-surface temperature. Both nymphs and adults migrate to cultivated crops when food in their natural habitat is scarce, the former following ravines and low land and the latter flying in swarms.

The use of poison baits against the nymphs of *M. m. devastator* seldom gives more than 50 per cent. control, as the amount of feeding is reduced by low spring temperatures and the baits are less attractive in the presence of succulent vegetation. In the autumn of 1943, large-scale experiments with unspecified poison bait were conducted against the adults in three widely separated counties, mainly on range land. The percentage reduction on the treated areas ranged from 80 to 99, and egg laying was almost entirely prevented. Outbreaks did not occur on any of the treated areas in 1944 and 1945, though nymphs migrated across the baited area in one county from untreated range into adjacent grainfields.

Camnula pellucida, Scud., and *Oedaleonotus enigma*, Scud., often accompany *M. m. devastator* on range land, but develop more rapidly than the latter, the females ovipositing in spring or early summer, shortly after reaching the adult stage. They are best controlled by poison baits applied to the egg beds in spring against the young nymphs, but autumn baiting is still necessary to eliminate the large numbers of *M. m. devastator* left on the range. Concerted action within an infested area is desirable, as absence of control in a few areas will leave enough grasshoppers to produce an outbreak in the following year.

Packard (C. M.) & Cartwright (W. B.). **The Hessian Fly in Indiana.**—*Bull. Ind. agric. Exp. Sta.* no. 440 (revd.), 15 pp., 5 figs., 1 ref. Lafayette, Ind., 1947.

This revision of an earlier bulletin on the Hessian fly [*Mayetiola destructor*, Say] on wheat in Indiana [*R.A.E.*, A **31** 382] is almost identical with the earlier one, but includes a statement that since 1935, some varieties of wheat have proved to be highly resistant to the Cecidomyiid and that some varietal resistance was found in preliminary trials with barley. The discovery of such resistant varieties for use as parents has made possible a breeding programme that promises to result in varieties that will be highly resistant and commercially desirable in Indiana.

Baerg (W. J.). **The Biology of the Maple Leaf Scale.**—*Bull. Ark. agric. Exp. Sta.* no. 470, 14 pp., 9 figs., 15 refs. Fayetteville, Ark., 1947.

Pulvinaria acericola, Walsh & Riley, which is a local pest of maple in the United States [*cf. R.A.E.*, A **35** 322], attracted attention in north-western Arkansas in 1930, and infestation of red maple [*Acer rubrum*] at Fayetteville had become so severe by 1933 that large trees were dead or dying. Other trees on which it has been observed in Arkansas are silver maple (*A. saccharinum*) and sassafras (*Sassafras variifolium*). Its food-plants and distribution in the United States are reviewed, and an account is given of observations on its bionomics in 1933–34 and 1944–45. The immature stages and adult males are briefly described.

The Coccid had only one generation a year. The eggs were laid in mid-June in masses of 677–3,433, mainly on the lower surfaces of the leaves, and the nymphs hatched in 15–19 days and settled along the midribs and larger veins of neighbouring leaves. They moulted after 30–40 days and migrated at the onset of cold weather in October to the twigs, where they settled on the bark and overwintered. They apparently entered the third instar in late April or early May and were then presumably unable to move, since nymphs on infested twigs brought into the laboratory remained attached to the bark and died there. Adult males emerged from about the middle of May, and the females returned to the leaves in late May and early June, having apparently lost their mouthparts. The females greatly outnumbered the males, but parthenogenesis has not been recorded in this species.

The natural enemies observed included the Coccinellid, *Hyperaspis signata*, Ol., which was not sufficiently numerous to control the Coccid, and Aphelinids of the genus *Coccophagus*; *C. lycimnia*, Wlk., completely eliminated an infestation on seedling sassafras and red maple in 1946.

Anderson (W. H.). **A Key to the Larvae of some Species of *Hypera* Germar, 1817 (=*Phytonomus* Schoenherr, 1823) (Coleoptera, Curculionidae).**—*Proc. ent. Soc. Wash.* **50** no. 2 pp. 25–34, 30 figs., 12 refs. Washington, D.C., 1948.

This paper contains a diagnostic description of the fourth-instar larva of the genus *Hypera*, keys to the fourth-instar larvae of 14 species, of which 13 occur in Europe and seven in North America, and collection records, usually including food-plants, for them.

Oman (P. W.). **Distribution of *Baldulus maidis* (De Long and Wolcott) (Homoptera, Cicadellidae).**—*Proc. ent. Soc. Wash.* **50** no. 2 p. 34. Washington, D.C., 1948.

A list is given of the available distribution records for *Baldulus* (*Cicadula*) *maidis*, DeL. & Wolc. In addition to Porto Rico [*R.A.E.*, A **12** 251; **28** 523], Cuba [**14** 266] and California [**23** 700], they comprise the States of Arizona, Florida, North Carolina and Texas, the Dominican Republic, Mexico, Costa Rica, Venezuela, Brazil, Peru and Argentina. The Jassid has at times been reported as a serious pest of young maize, while in Argentina it also attacks sugar-beet.

Fahey (J. E.) & Rusk (H. W.). **Ratio of labile Chlorine to total Chlorine in DDT Spray-residue Deposits in southern Indiana Apple Orchards.**—*J. Ass. off. agric. Chem.* **30** no. 2 pp. 349–354, 5 refs. Menasha, Wis., 1947.

Data accumulated during 1945 and 1946 from studies on DDT spray-residues deposited from a wide variety of spray schedules applied under orchard conditions in southern Indiana, in which analyses were carried out by the labile-chlorine and total-chlorine methods [*cf. R.A.E.*, A **38** 382] and the results are expressed as the ratio of labile to total chlorine, show that there was no accumulation of DDT degradation products on apple fruits or leaves after weathering [*cf.* **38** 384], and that the methods were satisfactory.

Cristol (S. J.), Soloway (S. B.) & Haller (H. L.). **Isolation of the o,o′-DDT Isomer from technical DDT.**—*J. Amer. chem. Soc.* **69** pp. 510–515, 1 graph, 7 refs. Easton, Pa., 1947.

The following is substantially the authors' summary. A procedure is reported leading to the isolation of o,o′ DDT from technical DDT in amounts of about 0·1 per cent. of the original product. The method involved isolation of the DDT-isomer fractions and crystallisation and chromatographic analysis and preferential dehydrochlorination of the more reactive DDT isomers, followed by oxidation of these products, leaving the unreactive o,o′ DDT. The structure of o,o′ DDT was proved by degradation, and a number of derivatives and compounds related to it are described. As an insecticide, o,o′ DDT was found to be relatively ineffective.

The isolation of m,p′ dichlorbenzophenone as a degradation product indicated for the first time the presence of m,p′ DDT in technical DDT.

Cristol (S. J.) & Haller (H. L.). **The Isolation of 1,1-dichloro-2-*o*-chlorophenyl-2-*p*-chlorophenylethane from technical TDE.**—*J. Amer. chem. Soc.* **70** pp. 1323–1324, 3 refs. Easton, Pa., 1948.

The following is substantially the authors' summary. A process is described by which 1,1-dichlor-2-o-chlorphenyl-2-p-chlorphenylethane (o,p′ DDD or TDE) was separated from a mixture with its p,p′ isomer. It makes use of the lower reactivity of the former with ethanolic sodium hydroxide. The rate constant for the reaction of o,p′ DDD with ethanolic sodium hydroxide was determined. Nitration and dehydrochlorination products of o,p′ DDD are described.

Goodhue (L. D.) & Hazen (A. C.). **Viscosity and Density of four Liquefied-gas Aerosol Solutions containing DDT.**—*Analyt. Chem.* **19** pp. 248–250, 2 figs., 4 refs. New York, N.Y., 1947.

The following is based on the authors' summary. The viscosities of four typical liquefied-gas aerosol solutions containing DDT were measured at temperatures of 25 and 30°C. [77 and 86°F.] by means of a special enclosed pipette, which is described. The densities of three of them at these temperatures were measured with a small hydrometer, and those of the fourth, which were out of the range of the hydrometer, with a special dilatometer. The viscosities ranged from 0·00352 to 0·00480 poise and the densities from 1·044 to 1·278 gm. per ml.

Fulton (R. A.) & van Dyke (M. J.). **Determination of small Quantities of Hydrogen Cyanide in Insects and Plant Tissue.**—*Analyt. Chem.* **19** pp. 922–923, 1 fig., 1 ref. New York, N.Y., 1947.

The authors describe a micromethod based on the formation of Prussian blue that was developed in connection with investigations on the control of *Aonidiella aurantii*, Mask., for the determination of small amounts of hydrogen cyanide absorbed in insect and plant tissue during fumigation. Ferrous sulphate was added to the distillate obtained from the treated material and allowed to react with it for five minutes at room temperature, after which the solution was acidified with dilute sulphuric acid and maintained at 25°C. [77°F.].

Exactly ten minutes after the addition of the ferrous sulphate the colour was determined with a neutral wedge visual-type photometer. Preliminary tests showed that variations in the colour from blue to a light green caused by ageing of the ferrous-sulphate solution could be prevented by acidifying this with sulphuric acid, after which it could be used for four hours with no change in colour of the Prussian blue, and that other variations in colour at constant temperature were due to the presence of air and could be prevented by carrying out the reaction in a vacuum. With this procedure, the determination could be made with an accuracy of ±1·5 per cent. in the range of 0·05–0·3 mg.

In an alternative method, in which starch indicator was added to the absorbing solution before distillation was begun, with enough iodine solution to give a faint blue colour, and the solution was titrated with iodine solution immediately distillation was finished, the results were affected by organic material removed by distillation, and it was necessary to correct this by making determinations on untreated insects.

BOWEN (C. V.) & POGORELSKIN (M. A.). **Determination of the Gamma-isomer Content of Benzene Hexachloride.**—*Analyt. Chem.* **20** pp. 346–348, 1 graph, 8 refs. New York, N.Y., 1948.

The author describes a cryoscopic method for the determination of the γ isomer content of technical BHC (benzene hexachloride) or mixtures of BHC isomers. It involves measurement of the depression that a sample of the material to be analysed produces in the freezing point of pure γ BHC, and can be carried out with readily available equipment in a relatively short time.

JACOBSON (M.) & HALL (S. A.). **Determination of Phosphorus in Hexaethyl Tetraphosphate and Tetraethyl Pyrophosphate.**—*Analyt. Chem.* **20** pp. 736–737, 1 fig., 5 refs. New York, N.Y., 1948.

The following is based on the authors' summary. A rapid and reliable procedure for determining phosphorus that is especially applicable to technical grades of tetraethyl pyrophosphate and hexaethyl tetraphosphate is described. Conversion of the organic phosphorus by alkali-nitrate fusion and digestion with dilute nitric acid is followed by the addition of ammonium vanadate and ammonium molybdate and reference of the percentage of light transmitted, after the solution has been allowed to stand, to a standard graph.

CUPPLES (H. L.). **Infrared Absorption Spectrum of Gamma-Benzene Hexachloride.**—*Analyt. Chem.* **21** p. 630, 1 fig., 2 refs. New York, N.Y., 1949.

The author reports that the infra-red absorption spectra of the isomers of BHC (benzene hexachloride) in the rock-salt range (2–15 μ) provide a method of quantitative determination of the isomers in technical and purified mixtures. The results obtained when the absorption of the γ isomer in this range was measured with an infra-red spectrometer equipped with sodium-chloride prism, windows and absorption cells, and using a solid glass or lithium fluoride shutter to minimise stray light, are compared with those of other workers using different ranges.

HOWARD (B. H.). **The Determination of small Amounts of Hexachlorocyclohexane (Benzene Hexachloride).**—*Analyst* **72** no. 859 pp. 427–431, 6 refs. London, 1947.

The following is based on the author's summary. A method is described for the analysis of insecticidal deposits of BHC (benzene hexachloride) or of residues of this compound in food, depending on extraction with ether followed by dehydrochlorination with monoethanolamine and subsequent determination of the separated chloride. The application of the method to wheat that had been treated with a BHC smoke and to deposits from smoke generators is recorded ; it might also be applied to residues in the animal body or blood.

BALD (J. G.), NORRIS (D. O.) & HELSON (G. A.). **Transmission of Potato Virus Diseases. VI. The Distribution of the Aphid Vectors on sampled Leaves and Shoots.**—*Aust. J. agric. Res.* **1** no. 1 pp. 18–32, 13 refs. Melbourne, 1950.

The following is largely the authors' summary of this sixth paper of a series [*cf. R.A.E.*, A **35** 156, etc.]. Data on the distribution on potato plants of *Macrosiphum solanifolii*, Ashm. (*gei*, auct.) and *Myzus persicae*, Sulz., the two local Aphid vectors of virus diseases, were collected at Canberra over the six seasons from 1941–42 to 1946–47. In the early stages of infestation, the counts of alate and apterous adults on the leaves approximated to a Poisson distribution, indicating random distribution in the crop. Moderate to high counts of nymphs diverged widely from a Poisson distribution. In the later stages of infestation, the total population showed an extremely non-random distribution, but examination revealed that this was due largely to the nymphs ; the adults, both alate and apterous, were distributed in a more nearly random way except when influenced by such events as heavy rainfall. The non-random distribution of the nymphs may be caused in part by their being deposited by gravid females on restricted areas of leaves offering favourable conditions, as was indicated by data obtained in 1943–44, and in part by the deposition of more than one nymph on each of a number of deposition areas visited at random by wandering gravid females, and a hypothetical example is given to show how such multiple deposition can result in heterogeneous distribution, even if it occurs on leaves chosen at random.

Sampled leaves were assigned to the ground cover or the median or tip zones of the plant according to the known phyllotaxy of the potato plant. The ground cover was divided into basal leaves, close to or touching the ground, and ground canopy, shading the ground, It was shown that *Myzus* deposits nymphs mainly on the ground canopy, and *Macrosiphum* on the basal two or three leaves and the tip. Adults of both species wander over all portions of the foliage.

The influences producing non-random distribution are discussed. In addition to those concerning individual leaves and affecting the distribution of the nymphs, they may comprise temporary or permanent differences in the attractiveness of individual plants, due to age, disease or varietal characters, and differences in the infestation of groups of plants, due most commonly to the presence of infested plants on the edge of a potato crop and to the effect of contours on wind and moisture conditions. It is suggested that the procedure for sampling Aphid populations on potato crops be modified to take account of the difference in infestation between basal leaves and ground canopy leaves, and that during sampling, leaves should be taken in turn from the base, ground canopy and middle and top foliage, only one leaf being taken from each plant [*cf.* **37** 413].

CLARK (L. R.). **On the Abundance of the Australian Plague Locust** *Chortoicetes terminifera* **(Walker) in Relation to the Presence of Trees.**—*Aust. J. agric. Res.* **1** no. 1 pp. 64–75, 7 refs. Melbourne, 1950.

The following is virtually the author's summary. By the use of belt transects through selected tree stands in the Bogan-Macquarie outbreak area of

Chortoicetes terminifera, Wlk., in New South Wales [*cf. R.A.E.*, A **38** 45, etc.], it was possible to show quantitatively that the abundance of non-swarming locusts is greatly limited by the presence of trees. Thus, if the former community dominants were re-established in those outbreak centres that were originally densely timbered, the production of swarms in them would probably be prevented and locust damage thereby reduced. It was found that the abundance of adult locusts within tree stands is not related to tree density, as such, but to a " barrier effect " of trees in depth acting in such a way as to diminish the chances that an individual will penetrate to a given depth in the stand as that depth is increased. Hoppers (predominantly in the fourth instar), the non-swarming residue of bands hatching outside tree stands, appear to be similarly affected. On the other hand, the population density of hoppers hatching within stands, both at the time of hatching and when the majority reach the fourth instar, is correlated with tree density as well as with distance within the stand, suggesting that adult female locusts are influenced by tree density in their selection of oviposition sites. The effect of tree density, as such, on the density distribution of locusts apparently disappears gradually as the locusts grow and become increasingly mobile, because after they reach the adult stage the relationship no longer exists.

The evidence obtained suggests that the limiting effect of trees on locust abundance is largely due to the reduction of light intensity that they bring about, the insects being affected through the medium of their positive phototactic response.

MUNGOMERY (R. W.). **Report(s) of the Division of Entomology and Pathology.**—*48th Rep. Bur. Sug. Exp. Stas Qd 1947–48* pp. 31-40. Brisbane, 1948 ; *49th Rep. . . . 1948–49* pp. 36–45, 2 pls., 1 graph. 1949.

Sugar-cane in Queensland was in general not severely damaged by insect pests in 1947–48 and 1948–49. In both years, *Dermolepida albohirtum*, Waterh., caused some localised injury, and at the beginning of 1949, some infestations in north Queensland were the heaviest recorded since 1934. Losses were less severe than in other years in which outbreaks have occurred, however, owing to the use in areas liable to heavy infestation of protective dressings of BHC (benzene hexachloride) [*cf. R.A.E.*, A **38** 89] ; the excellent condition of the stands in treated fields provided a marked contrast with the uprooted and dying cane in untreated fields. In the Lower Burdekin and Giru areas, where infestation was heavy and caused an appreciable reduction in both quality and yield in 1947–48, an attempt has been made over several years to poison the trees on which the adults feed. Some freedom from attack was reported in some areas as a result, but in others it caused the beetles to concentrate on the fringe of the remaining trees and infest nearby areas.

Preliminary laboratory and field tests in 1947–48 showed that chlordan was of little value against the larvae, and experimental work on chemical control was concerned with BHC. Pyrophyllite had previously been used as the sole diluent for the recommended 10 per cent. dust (1·3 per cent. γ BHC), but as it did not settle quickly a substitute was sought. Finely ground rock phosphate showed promise, and though field trials with it were inconclusive owing to light infestation, a mixture comprising 10 per cent. BHC, 75 per cent. ground rock phosphate and 15 per cent. pyrophyllite, which was included to prevent caking during grinding and mixing, was adopted as the standard dust. Evidence from field trials indicated that the effectiveness of BHC dusts depends largely on placing them correctly in relation to the cane. They gave best results against *Dermolepida* when applied to the drill after germination ; broadcast application necessitated the use of about three times as much dust to give equivalent control. Experiments in north Queensland, where infestation was low and damage slight or moderate, indicated that the 10 per cent. dust gave effective control when applied to the drills at the rate of 50 lb. per acre on heavy soils and at 75 lb. on friable soils. In the Mackay area, where infestation was also low, 75 lb. dust per acre applied in bands along the drills before the flight period appeared to give complete control in the plant crop, but in the Burdekin area, where it was high, rates of 75–80 lb. per acre applied by the growers were not wholly effective, either because they were too low or because of the practice of hilling the rows for irrigation. Evidence was obtained in 1948–49 that a rate of 75 lb. per acre gives satisfactory control where protection for only one season is required, though some wilting and discoloration of the leaves occurred in a heavily infested plot treated at this rate, whereas others treated at rates of 100 lb. or more were undamaged.

Evidence of the excellent persistent effects of BHC was obtained in several areas. The toxic effects of a dust applied at only 50 lb. per acre to plant crops on heavy soil at Johnstone persisted on the ratoon crops under conditions of light to moderate infestation in 1947–48, and no benefit resulted from a further application at the same rate made to the young ratoons. On light soil, rates of 50–400 lb. per acre applied to the plant crops gave protection varying from fair to good against light infestation in the following ratoon crop, but plots treated at initial rates of 50 and 75 lb. that also received a supplementary application of 50 lb. per acre showed a marked improvement over those that did not. In the Mulgrave area, the first ratoon crop in plots of cane that had been treated at rates of 125 lb. or more per acre in November 1946 was practically free from infestation and damage in May 1948, when neighbouring untreated plots were badly damaged ; damage in plots that had been dusted at lower rates varied from slight in those that received 100 lb. per acre to severe in those that received only 12½ lb. No advantage was obtained from a supplementary treatment of the first ratoons at 50 lb. per acre when the initial rate had been 75 lb. or more. The observations were continued on the second-ratoon crops in 1948–49. Those that had been dusted at rates of 150 and 200 lb. per acre in November 1946 and received no additional treatment remained free from injury, but considerable damage developed in those that had received only 100 lb., and injury was severe in untreated plots. The yields per acre in June 1949 were 20·1, 20·71, 17·71 and 10·18 tons, respectively, the differences (except between the two higher rates) being highly significant. The total yield per acre from the plot treated at 150 lb. was 20 tons heavier over the three years than that from the control, but this does not represent the maximum possible increase, since crops that were heavily infested were harvested early to avoid serious deterioration and infestation was heaviest at the end of the cropping cycle. The control in some plots that received initial dressings of 80 and 90 lb. dust per acre and no supplementary treatment was not satisfactory in the second year, and supplementary dressings of 40–50 lb. per acre applied by the growers in 1948–49 to fields treated in 1947 proved of value.

Larvae of *Lepidiota frenchi*, Blkb., and *L. consobrina*, Gir., did not cause much damage in 1947–48, but fairly dense flights of *L. frenchi* and other Lamellicorns with a two-year life-cycle took place in December 1948. Some evidence was obtained in the Hambledon area in 1948–49 that 20 per cent. BHC dust applied at 50–150 lb. per acre in furrows on either side of the plant cane after stooling prevents damage by *L. frenchi* in the subsequent first ratoons. Larvae of *L. frenchi* and *D. albohirtum* often occur in the same fields, and dust at the rate recommended for the control of the latter on a three-crop basis will probably also be of value against the former. *Pseudholophylla furfuracea*, Burm., and *L. consobrina* caused localised damage in the Bundaberg district in 1948–49.

Damage by *Lacon variabilis*, Cand., increased in severity and extent in 1947–48 in the Mackay area because low-lying blocks, which are the ones usually infested, were planted earlier than usual. Weather conditions did not favour the survival of the young wireworms, however, and there was no noticeable increase in its numbers. Confirmation of the effectiveness of BHC dusts applied in combination with fertilisers in protecting germinating setts [**38** 89] was obtained in 1948–49, when the practice of applying 10 lb. 20 per cent. dust with 3 cwt. fertiliser per acre at planting time was generally adopted. No special care was taken to prevent the mixture from coming in contact with the setts, and no significant decrease in crop was noted when it did [*cf.* **38** 137].

A few small, loose swarms of locusts, mostly *Chortoicetes terminifera*, Wlk., occurred during the summer of 1947–48 in the western parts of the Mackay district. In the same year, *Mastotermes darwiniensis*, Frogg., caused a small amount of damage in the Burdekin area ; a dust containing 10 per cent. BHC applied in the cane rows at planting time was ineffective against it at rates as high as 40 lb. per acre, and the destruction of nests in uncultivated ground adjoining the canefields appears to be the only measure likely to afford permanent control. In the same area, the Tineid, *Opogona glycyphaga*, Meyr., destroyed buds on one variety of sugar-cane by boring into them, but the damage was mainly confined to stools near the headlands. In central Queensland, a minor outbreak of the Eumolpid, *Rhyparida morosa*, Jac., affected poorly grown cane in two areas. *Rhabdoscelus obscurus*, Boisd., continued to be scarce in both seasons [*cf.* **35** 367], presumably owing to the practice of burning all crops prior to harvesting and to the absence of serious outbreaks of top rot [*cf.* **34** 1], but evidence was also obtained in 1947–48 that the increased use of new cane varieties with hard rinds was also responsible. *Margarodes* sp. was found on the roots of P.O.J. 2878 ratoon cane at Nikenbah in south Queensland in 1947–48 and was also present there in the following year. The ant, *Aphaenogaster pythia*, Forel, undermined the stools and caused stunting in the Tully district in both years. *Aulacaspis madiunensis*, Zehnt., was observed on standover cane of the variety Q 47 in the Qunaba area in 1948–49 and in view of a previous record [**29** 389], infestation by this Coccid should be considered in developing new standover varieties.

Kelsey (J. M.). **A Note on the Life-cycle of** *Anobium punctatum* **De Geer.**—*N.Z. J. Sci. Tech.* **30** (B) no. 4 pp. 211–214, 1 fig., 2 refs. Wellington, N.Z., 1950.

Experiments were begun in New Zealand in 1943 to determine whether the susceptibility of timber to attack by *Anobium punctatum*, Deg., is correlated with the duration of the seasoning period. Small blocks were cut from sapwood of *Dacrydium cupressinum*, *Podocarpus dacrydioides*, *P. totara*, *Pinus radiata* (the exact identification of which was uncertain, since several species of conifers are milled under this name) and *Beilschmiedia tawa*, and were stored under cover for seasoning ; all except those used in the first year were dressed all round and subjected to the muslin bandage technique [*R.A.E.*, A **35** 418]. Groups of three uninfested blocks of each species were exposed each year to five males and five females of *A. punctatum*, and the observations in 1947 on blocks exposed in 1943 or 1944 are here presented.

Adults emerged after a minimum of four years from air-dried *Pinus radiata* that was exposed to infestation less than one year after milling, and after three years from air-dried *Podocarpus dacrydioides* ; both kinds of timber contained some larvae that would require at least one year longer to complete their development. Kiln-dried *Pinus radiata* contained living larvae after four years, but they were much smaller than those of the same age in the air-dried timber ; four-year-old larvae were present in both air-dried and kiln-dried *B. tawa* and were of about the same size as those in kiln-dried *P. radiata*. No living larvae were recovered from four-year-old air- or kiln-dried

D. cupressinum or air-dried *Podocarpus totara*, though the larvae had tunnelled for distances of ⅜ in., and in the case of air-dried *D. cupressinum* over 1⅜ ins., before dying.

Dumbleton (L. J.). **The economic Status of** *Metoponia rubriceps* **Macquart.**—*N.Z. J. Sci. Tech.* **30** (B) no. 4 pp. 224–232, 7 refs. Wellington, N.Z., 1950.

The Australian Stratiomyiid, *Metoponia rubriceps*, Macq., was reported from Opotiki, New Zealand, in 1944 [*R.A.E.*, A **33** 375] and was known by 1948 to occur within a radius of seven miles from that township. Notes are given from the literature on its bionomics in Australia, where it is a local minor pest of sugar-cane in Queensland [*cf.* **14** 576 ; **21** 151 ; **23** 266], with its flight period in May–June, and also occurs in New South Wales, with flights in October–December and April. Its bionomics in New Zealand appear to resemble those in New South Wales, the adults flying in late March and April, with one observed case of emergence in late November.

In view of local reports that the larvae cause premature deterioration of pastures and the failure of maize crops, especially the first crop after grass [*cf.* **33** 376], attempts were begun at Opotiki in 1947 to demonstrate their responsibility for the damage. It was first sought to compare the growth of pasture in infested and uninfested soil by eliminating the larvae from part of a heavily infested pasture composed of *Paspalum*, rye grass [*Lolium*], and clover, in which populations of up to 500 per sq. ft. were found. The treatments adopted comprised watering the surface with an emulsion of 250 ml. dichlorethyl ether with 25 ml. emulsifier in 25 gals. water on 31st July, and injecting chlorpicrin or Shell D.D. [equal parts dichlorpropane and dichlorpropene] into the soil to a depth of 6 ins. in holes 10 ins. apart at 2 ml. per hole on 20th October ; no treatment had much effect on the larvae and the last two injured the pasture.

Observations were also made in a field of oats that were sown in April 1947 on a ploughed-up pasture from which the rye grass had died out. The oats made poor growth in at least half the field, and the distribution of the poor plants was stated to be correlated with the composition of the previous pasture. The numbers of larvae on 31st July in soil samples 12 sq. ins. in area averaged 18·2 and 12·8 in two areas of poor oat growth, 3·4 in an area of dense growth, and 27·2 among the remaining oat plants in a bare area. The differences between the lowest and the two highest of these figures were significant. The field was then subjected to different cultural treatments and sown with maize. Half was ploughed on 1st August, rolled, double-disked and harrowed on 14th–15th August and again on 17th–18th September, and cross-disked on 21st October, and the other half was ploughed on 20th October and rolled, disked and cross-disked on 21st October ; both were harrowed on 25th October. Plots in each half were treated with insecticides between 19th and 21st October and sown with maize on 29th October. The insecticides comprised a dust containing 2 per cent. p,p′ DDT worked into the soil to a depth of 3 ins. over a strip 12 ins. wide at a rate of 7½ lb. per 11 yds. of row and chlorpicrin or Shell D.D. injected over the whole plot at intervals of 10 ins. at 2 ml. per injection. On 20th November, when the plants were about 6 ins. high, and also in mid-December, growth was significantly better on the half that was ploughed early, and there were differences between late-ploughed plots on the latter date. By early January 1948, the plants on the plots in this half of the field that were treated with chlorpicrin and Shell D.D. were 18–24 ins. taller than those in the controls, though these differences tended to disappear in February. The mean numbers of larvae per plant in the late-ploughed plots in January were 16·73, 13·16, 9·26 and 37·46 for DDT, Shell D.D., chlorpicrin and no treatment, respectively, the differences between all treatments and none and between treatment with chlorpicrin and DDT being significant ; the corresponding figure for the early-ploughed untreated plots was 4·56. Results based on the yield per 100 plants were not entirely valid, but there appeared to be no significant difference between the treated and untreated plots in the late-ploughed part of the field or between the two ploughing dates. The grower estimated that the yield from the half that was ploughed early was 20 per cent. greater than that from the other.

It is concluded that although significant yield differences were not shown, the growth of the maize was correlated with populations of *Metoponia*. It seems likely that the damage is mainly to the adventitious roots or the nodes that produce them. Ploughing three months before planting, followed by cultivation, gave significant reductions in population, and these were not increased by the use of insecticides, which would in any case be prohibitively expensive on maize.

MILLER (D.). **Control of Gorse by Seed Weevil.**—*N.Z. J. Agric.* **75** no. 4 pp. 341–344, 8 figs. Wellington, N.Z., 1947.

The author describes the life-history of *Apion ulicis*, Forst. [*cf. R.A.E.*, A **16** 540], which was introduced into New Zealand for the control of gorse [*Ulex europaeus*] and has become established [*cf.* **36** 244], and gives a list of the numerous places at which it has been liberated. In New Zealand, the egg, larval and pupal stages last about 4, 6–8 and 2 weeks, respectively, and adults emerge from the pods during December and January in Nelson and as late as March and April in Otago. They overwinter at the bases of buds and spines and are stimulated to temporary activity on sunny and warm winter days. Since official distribution of the weevil has now ceased, directions are given for collecting any that may be required from areas when it is already established. The highest percentage of gorse pods found to be infested by it in New Zealand is nearly 99, and its abundance in many areas suggests that this high rate of infestation is likely to become general.

FLOCH (H.). **Activité du D.D.T. sur quelques coléoptères xylophages.**—*Publ. Inst. Pasteur Guyane* no. 154, 4 pp., 1 ref. Cayenne, 1947.

In July and August 1946, newly felled forest trees in French Guiana were found to be severely infested within a few days by the Scolytids, *Xyleborus subaffinis*, Eggers, and *X. longipennis*, Eggers, and Platypodids of the genera *Platypus* and *Tesserocerus*. In experiments with insecticides, DDT was used as a 5 per cent. solution in kerosene and the other materials in water. In the laboratory, DDT gave complete mortality of larvae, pupae and adults in five days, while timbo powder [*Lonchocarpus*] containing 5 per cent. rotenone, and the powdered dried seed of *Mammea americana* were ineffective. When sections on the trunks of two newly felled and barked softwood trees in a heavily infested area were treated in early August with DDT, rotenone, cresylic acid, an arsenical or bordeaux mixture, and the intervening sections left untreated, all sections were found to be infested after 20 days except the one treated with DDT, and this was still free from attack 51 days after treatment. A further test later in the month with rotenone and DDT gave similar results. It is concluded that DDT would afford protection until the wood was removed from the forest, but as DDT is scarce in French Guiana, the bark and the sapwood were removed from felled hardwoods, and this proved effective.

SUN (Yun-pei). **An Analysis of some important Factors affecting the Results of Fumigation Tests on Insects.**—*Tech. Bull. Minn. agric. Exp. Sta.* no. 177, 104 pp., 37 figs., 10½ pp. refs. [St. Paul, Minn.] 1947.

The following is almost entirely from the author's summary. Extensive studies were made to determine some of the important factors that should be controlled before, during, and after fumigation tests with insects. The factors studied included temperature, relative humidity, nutrition, starvation, sublethal fumigation, and population density. So far as possible, one factor was varied and the others held constant. To eliminate other possible sources of error, standard cultures of insects were reared at 25°C. [77°F.] and 60 per cent. relative humidity in cabinets from which excessive carbon dioxide was removed, and the fumigations were carried out at the same temperature and humidity, with an exposure period of five hours. The test insects were chiefly *Tribolium confusum*, Duv., *Calandra* (*Sitophilus*) *granaria*, L., and *C.* (*S.*) *oryzae*, L.

Complete mortality curves for all stages of *T. confusum* from day-old eggs to adults 24 weeks old were obtained by fumigating with carbon bisulphide. The resistance of the eggs decreased greatly and constantly as the embryos developed, and the same rate of decreasing resistance appeared to continue for the first week of the larval stage. Resistance then increased slowly, but steadily, until the larvae pupated. The pupae were considerably more resistant than the larvae ; their resistance decreased slightly until the third day, increased greatly until the sixth day, and then decreased sharply. Throughout the pupal stage, susceptibility to fumigation is closely correlated with rate of respiration. Newly emerged adults were about as resistant as newly formed pupae, but older adults were less so, their resistance decreasing markedly when they were four days old, subsequently increasing again and then slowly decreasing, there being little change in the resistance of adults over two weeks old. The resistance of adults of *C. granaria* and *C. oryzae* to carbon bisulphide was similar to that of *T. confusum*, but showed no depression at the fourth day.

Temperature was the factor that produced the most striking differences in the fumigation results. Adults of *T. confusum* reared at 30 and 35°C. [86 and 95°F.] were more susceptible to carbon bisulphide than those reared at 25°C. If, however, on reaching the adult stage, they were transferred to 25°C. for four weeks before fumigation, their susceptibility was almost the same as that of adults reared and kept at 25°C. The results of experiments with stocks of insects that have been reared quickly by using a high rearing temperature and then conditioned at a lower one can therefore be compared with those of experiments with insects reared at the lower temperature. There was little difference in mortality among adults of *T. confusum* that had been reared at a constant temperature, transferred to temperatures of 5, 10 or 15°C. [41, 50 or 59°F.] for three days, and then subjected to standard fumigation, but at higher preconditioning temperatures, mortality increased rapidly. In the case of adults of *C. granaria*, mortality first decreased, then increased, and finally decreased again as preconditioning temperatures were increased. The preconditioning effect of relative humidity, of which seven values covering the complete range were tested, was not as great as that of temperature. Mortality increased among adults of *C. granaria* that had been preconditioned at either low or high humidities, but adults of *T. confusum* were less affected at high than at low humidities.

Uneven distribution of fumigants in a 6·4-litre flask caused a very great variation in the concentration of fumigants at different layers. These differences were measured indirectly by the time required for 50 per cent. locomotory paralysis among adults of *T. confusum*. In addition, differences in actual mortality were found at different layers during the fumigation of adults of *T. confusum* with carbon tetrachloride when the fumigant was not well mixed.

In experiments on the effect of temperature during fumigation, the susceptibility of eggs of *T. confusum* to carbon bisulphide decreased with the temperature until it reached 5°C., but increased again at 0°C. [32°F.]. There is a straight-line relationship between fumigation temperature and median lethal concentration of carbon bisulphide from 10 to 30°C. Relative humidity during fumigation affected the eggs most and the active stages least. The exposure period of five hours was too short to produce a substantial effect on the active stages, even if the rate of metabolism was changed slightly. In the inactive stages, the entrance of a fumigant depends entirely upon its diffusion through the outside chorion, which may change in permeability at different relative humidities.

The general trend of sorption ratios of eight fumigants followed the order of their boiling points, except for methyl acetate, which deviated to a greater, and ethylene dichloride, which deviated to a less, degree. In general, the higher the boiling point of the fumigant, the greater was the weight of sorption. With regard to their solubility in water, methyl acetate was found to be very, and ethylene dichloride, slightly soluble, whereas other fumigants were almost insoluble. A method for the determination of the relative penetration of fumigants through flour is given. In the group of eight fumigants on which it was employed it appears that the higher the boiling point or the higher the sorption ratio of a fumigant, the smaller will be the amount of vapour that will penetrate through patent flour. Chlorpicrin did not penetrate well ; the common view that it does may arise from the fact that its odour can be detected at very low concentrations.

The general relation between boiling point and toxicity is shown for 20 fumigants and the three species of insects in a table. Fumigants with either low or high boiling points are more toxic than those within the middle range (about 55–80°C. [131–176°F.]). Very toxic fumigants are found with extremely high or extremely low boiling points. The values of those fumigants that show a delayed kill are often far from the general trend.

When larvae and adults of *T. confusum* and adults of *C. granaria* were kept at various temperatures between 5 and 35°C. after fumigation, mortality was in general high at 5°C., decreasing to a minimum at about 20–25°C. [68–77°F.], and increasing again above 25°C. This may be the result of the combined effect of the chemical action of the fumigants on the insects, desorption of fumigant vapour, and the activity of the insects.

Various criteria of death are discussed, and it is considered desirable to include mortality assessed on both the second and tenth day after fumigation when describing the susceptibility of insects to fumigants. In studying the relation between the concentration of a fumigant and exposure time, the equation $C\ (T-x)=K$, where C is the concentration, T is the exposure time required for 50 per cent. mortality, x is the time required for the fumigant to diffuse into the vital centre before building up a constant flow of fumigant, and K is a constant, is valid for concentrations of carbon bisulphide between 20 and 200 mg. per litre.

Other factors that produced some effect on fumigation results were population density, starvation before and after fumigation, exposure period, and post-fumigation humidity. Mortality after fumigation increased as the density of adults of *C. granaria* in 30 gm. wheat decreased from 300 to 50. Factors other than density were of minor interest.

TODD (F. E.), LIEBERMAN (F. V.), NYE (W. P.) & KNOWLTON (G. F.). **The Effect of Field Applications of Insecticides on Honey Bees.**—*Agric. Chem.* **4** no. 8 pp. 27–29, 77, 2 graphs, 10 refs. Lancaster, Pa., 1949.

The results are given of a field experiment carried out near Logan, Utah, to determine the effect on honey bees of applications of DDT, chlordan, parathion and toxaphene to flowering lucerne. On 1st September, 1948, eleven colonies of bees were put approximately 30 ft. from two acres of flowering lucerne. Various insecticidal dusts were applied in sequence to the entire flowering area in the early morning, before the bees had left the hives, and the interval between applications was 48 hours, or longer if that was necessary to permit bee activity to return to normal. Daily counts were made of the recently dead bees in the field and near the hives, and the numbers, after allowance for natural mortality, were expressed as percentages of the number of bees estimated to have visited the field. These mortality percentages were 23 for 5 per cent. chlordan applied at 22 lb. per acre on 9th September, 8 for 10 per cent. toxaphene at 19 lb. on 13th, 28 for 3 per cent. DDT at 30 lb. on 15th, 2 for 10 per cent. toxaphene at 28 lb. on 21st, and 40 for 1 per cent. parathion at 23 lb. on 23rd. The fact that mortality was low after each application of toxaphene indicated that the accumulation of insecticides did not obscure the results of any one test. The prevailing temperatures allowed for at least six hours of flight by the bees each day, but there was a progressive decline in the extent to which the bees visited the field as the amount of bloom decreased. Death of bees after treatment with DDT, chlordan and toxaphene was apparently confined to the field force and occurred mainly in the field, but two-thirds of the dead bees were found about the hives after treatment with parathion, and it is possible that there was mortality among the house bees. Parathion was the most and toxaphene the least toxic of the insecticides tested. Deaths occurred chiefly during the two days after application. DDT acted as a repellent and tended to limit the total number of deaths by reducing the numbers of bees collecting in the field.

It is concluded that the dusting of flowering lucerne with insecticides over a considerable proportion of the bee range during a honey flow may reduce the honey yield markedly, but the low mortality of bees caused by toxaphene, if maintained in tests under other conditions and on a large scale, indicates a wider use for this material in insect control.

ROHWER (S. A.). **Initial Flavor and Odor Studies with Benzene Hexachloride.**—*Agric. Chem.* **4** no. 8 pp. 35, 75, 77. Lancaster, Pa., 1949.

The extent to which individual isomers of BHC (benzene hexachloride) and a mixture of them affect the odour and flavour of fruit and vegetable crops was investigated in 1948. Chemically pure α, β, γ and δ isomers were obtained by recrystallisation from organic solvents, tested for purity by melting-point determination and infra-red spectrometer analysis, and prepared as 25 per cent. wettable powders, and the four pure isomers were mixed in the proportions found in the technical BHC from which they were derived and made into a similar wettable powder. People preparing the materials found the γ isomer to be relatively odourless and non-irritating, whereas the α, β and δ isomers caused various degrees of irritation to the eyes, nose, throat and skin.

In one series of tests, dusts containing 10 per cent. isomer were applied to the developing foliage or fruit of rhubarb, spinach, broccoli, sweet maize, tomato, snap bean, lima bean and potato three times at weekly intervals during the growing season ; in another, the wettable powders were incorporated in sassafras loam soil at rates based on the proportions found in the original compound, and potatoes, tomatos and lima beans were grown in it ; and in the third, the wettable powders were compared in doses in the same proportions in sprays applied to peaches 18 days before harvest. The edible part of each experimental crop was harvested as usual and tested for odour and taste. Each isomer affected odour and flavour of the edible portions of some crops when applied to the aerial parts of the plant or mixed in the soil, but the δ and β isomers did so more often and more strongly than the α and γ isomers. The δ isomer was the only one that injured the plants when applied to the parts above ground.

The results indicate that most of the off-flavour in products treated with the BHC may be due to the presence of the α, β and δ isomers, and that BHC formulations should contain the minimum practical quantity of the δ isomer where plant safety may be involved and of both the β and δ isomers where the flavour or odour of the edible portion of plants may be affected. Most of the α isomer should also be eliminated if possible. It is concluded that BHC, which has proved very effective in the control of various insect pests, should not be neglected for fear of crop contamination until thorough tests have been completed with formulations of essentially pure γ isomer.

Jeppson (L. R.). **Field Studies with new Chemicals for Control of Citrus Mites.** —*Calif. Citrogr.* **32** no. 8 p. 331, 3 refs. Los Angeles, Calif., 1947.

In 1942–47, over 100 new chemicals were tested for the control of the citrus bud mite [*Aceria sheldoni*, Ewing] on *Citrus* in California, and extensive field tests were made with di-2-ethylhexylphthalate, a dicyclohexylamine salt of dinitro-o-sec.-butylphenol (DN-211) and DDT, three of the most effective. When used in spray emulsions at 1 quart per 100 gals., di-2-ethylhexylphthalate, a liquid that is miscible with the common organic solvents but practically insoluble in water, gave control comparable with 1·5 per cent. light-medium oil spray and at twice this strength it was generally more effective than the regular oil-spray application, with no injury to lemon trees or fruit. Spray suspensions of DN-211 at 1 lb. per 100 U.S. gals. water generally gave good control except when heavy rains followed soon after application ; the very young leaves were slightly scorched when high temperatures occurred soon after treatment. A 3 per cent. water emulsion of 4 per cent. DDT in kerosene gave satisfactory mite control in field experiments, but suspensions of DDT or emulsions using less kerosene did not. As DDT has adverse effects on beneficial insects, its use where this mite is the only pest to be controlled would probably not be advisable.

In tests against the citrus red mite [*Paratetranychus citri*, McG.], DN-dust D8 and DN-111 (1·6 and 20 per cent. dicyclohexylamine salt of dinitro-o-cyclohexylphenol) were generally less effective than the regular oil sprays. Unsatisfactory control was usually the result of inadequate methods of application or rainfall soon after treatment, but in some cases other causes appeared to be involved. Di-2-ethylhexylphthalate and di(4-chlorphenoxy)-methane were two of the most promising of several compounds tested against *P. citri* and its eggs. In laboratory and field experiments, the phthalate at a concentration of 1 : 400 was as effective as 1·5 per cent. light-medium oil. When emulsified solutions or wettable-powder sprays containing 1 lb. of the methane per 100 U.S. gals. water were applied to lemon trees in November, December and January, the deposits were toxic to mites put on the picked fruit after 30 days, and deposits on grapefruits killed mites 60 days after treatment. In the field, sprays containing di(4-chlorphenoxy)methane in emulsified solutions or wettable powders and dusts containing it all gave effective control ; regular applications of 3 gals. 4 per cent. di(4-chlorphenoxy)-methane in kerosene per 100 gals. water or 2 lb. 50 per cent. wettable powder per 100 U.S. gals. gave control comparable with similar applications of light-medium oil emulsions. The addition of 1 quart light-medium oil or 1 gal. kerosene per 100 gals. of the suspensions increased effectiveness when applications were made immediately before rainy weather. Formulations containing oils or aromatic solvents appeared to be the more effective in preventing the eggs from hatching. Dusts containing 3–5 per cent. di(4-chlorphenoxy)methane were generally more effective than DN-dust D8 at comparable dosages, and they apparently remained sufficiently toxic to prevent development of mites that hatched from eggs present at the time of treatment, provided that they were not washed off by rain. Concentrate sprays containing 3–5 lb. di(4-chlorphenoxy)methane per 100 U.S. gals. water showed promise when applied in an air blast by a spray duster at 100 U.S. gals. per acre, although the distribution of deposits was not perfect, and the addition of oil or kerosene to concentrate sprays containing wettable powders appeared to increase effectiveness during the rainy season. Di(4-chlorphenoxy)methane did not give satisfactory control when applied by means of fog generators. Field tests with hexaethyl tetraphosphate showed it to be toxic to the adults and young ; as it did not appear to prevent the development of the eggs or to have any residual action, two or more applications would probably be necessary for adequate control.

The control of the six spotted mite [*Tetranychus sexmaculatus*, Ril.] is complicated by its habit of feeding in depressions on the lower leaf surface and webbing them over. Treatments before many of the depressions were formed were generally more effective than applications made after populations had become well established. Regular applications of di(4-chlorphenoxy)-methane in sprays at 1 lb. per 100 U.S. gals. or as a 5 per cent. dust at 100 lb. per acre appeared to be more effective than the standard oil sprays. Di-2-ethylhexylphthalate was effective when applied before the mites had webbed themselves over but not afterwards.

Cagle (L. R.) & Jackson (H. W.). **Life History of the Garden Fleahopper.**—*Tech. Bull. Va agric. Exp. Sta.* no. 107, 27 pp., 7 figs., 3 refs. Blacksburg, Va., 1947.

An account is given of laboratory studies on the bionomics of *Halticus bracteatus*, Say, carried out in Virginia in 1944–45 in conjunction with work on its control [*R.A.E.*, A **36** 394]. All stages of the Mirid and the rearing technique are described ; the food for both nymphs and adults was white clover. The work began with field-collected nymphs thought to have hatched from overwintered eggs. Five generations were reared each year, and only eggs overwintered. The generations overlapped, and it was observed in 1945 that adults of all except the overwintering one were present until the end of the season. In that year the overwintered eggs hatched between 13th April and 14th May, but some had hatched earlier in the field and the first summer eggs laid by females of field-collected material were deposited on 30th April. Overwintering eggs were laid from mid-August, their proportion increasing as the season advanced until all those of the last overwintered. This coincided with an increasing tendency for eggs to be deposited in the corks of the rearing cages rather than in the plant parts. The last egg to hatch in autumn was laid in mid-September, and the last overwintering egg in mid-November.

The duration of the egg stage for summer eggs ranged from 10 days each year at an average of 73·7°F. to 28 days in 1945 at 59·6°F. Some eggs hatched after abnormally long periods (56–78 days) in the autumn of 1945, and this was attributed to winter eggs hatching owing to favourable conditions in November. The nymphal staged lasted 11–35 days in 1944 and 11–48 in 1945, the temperatures averaging about 74°F. during the minimum periods and about 54°F. during the maximum ones. The preoviposition and oviposition periods ranged from 1 to 21 days and 1 to 73 days, respectively, in 1944 and from 1 to 17 and 1 to 83 days in 1945. The maximum number of eggs laid per female was 217 in 1944 and 203 in 1945. The adult males and females survived for up to three months or more. All the females reared were brachypterous.

FRONK (W. D.). **The Southern Pine Beetle—its Life History.**—*Tech. Bull. Va agric. Exp. Sta.* no. 108, 12 pp., 7 figs., 4 refs. Blacksburg, Va., 1947.

Field and laboratory studies on the bionomics of *Dendroctonus frontalis*, Zimm., the immature stages of which are briefly described, were begun in Virginia during the summer of 1946, when there was a severe outbreak of this bark-beetle on mature pine near Chase City. All four stages were present in logs and bark of shortleaf pine [*Pinus echinata*] collected on 28th April 1946, and all but the eggs and first-instar larvae in logs and bark collected on 1st April 1947. The winter is passed in any stage. The eggs were laid singly in niches 4–20 mm. apart in long, wandering tunnels constructed by the adults; the tunnels made by the larvae were at first thread-like, but became abruptly wider after the first moult. Only the adults and the first-instar larvae cut into the cambium layer. There were four larval instars, and pupation occurred in a cell in the outer bark. In the insectary, the egg, larval and pupal stages lasted 3–9, 25–38, and 8–11 days, respectively, and total development 40–54 days. Emergence occurred intermittently from 24th May until the 18th December in 1946, with peaks between 18th June and 11th July, 30th July and 16th August, 4th and 27th September, 22nd October and 11th November, and 24th November and 14th December, and it is assumed that there were four generations and a partial fifth. The sexes emerged from the logs in approximately equal numbers, and in general not more than one adult of each sex was found in a single tunnel.

Studies in which infested logs were cut into one-foot lengths and the sections sealed with paraffin wax and kept for various periods at different temperatures showed that the pupal stage was the one most resistant to cold. Exposure to 0°F. for more than a week caused complete mortality of all stages, and though some of the eggs hatched after exposure to this temperature for one week, the larvae died almost immediately. In experiments in which similar logs were weighed regularly to determine loss of moisture, the numbers of adults that emerged was much larger when the loss was between 19 and 28 per cent. than when it was less or greater.

Many of the adults of *D. frontalis* in the bark were attacked by adults of *Tenebroides collaris*, Sturm, *Temnochila virescens*, F., and *Thanasimus dubius*, F., which cut their way through the bark in search of them, and the larvae and pupae were attacked by the larvae of these predators. In the insectary, a late-instar larva of *T. dubius* consumed 96 larvae of *D. frontalis* before pupating. This Clerid overwinters in the adult and larval stages and pupates in a cell in the outer bark. Nymphs and adults of the Anthocorids, *Lyctocoris elongatus*, Reut., and *Scoloposcelis flavicornis*, Reut., fed on the eggs and larvae of *D. frontalis*, and a Dolichopodid of the genus *Medetera* was sufficiently numerous to exert slight control. Two of the commonest parasites were *Coeloides pissodis*, Ashm., and *Cecidostiba dendroctoni*, Ashm., which were present throughout the year; one example of *Microchrysa polita*, L., a Stratiomyiid that attacks the larvae, was found. Six species of mites were associated with *D. frontalis* under the bark. They included *Histiogaster carpio*, Kramer, and *Gamasus* (*Parasitus*) sp., which fed on the larvae, and a species of *Uropoda*, which is not parasitic but clings in numbers to the bodies of the beetles and probably hinders their movements; examples of this mite or the pedicels of excrement left by them were found on 80 per cent. of the beetles and one beetle bore 40 nymphs.

WALTON (W. R.) & PACKARD (C. M.). **The Armyworm and its Control.**—*Fmrs' Bull. U.S. Dep. Agric.* no. 1850 (revd.), 10 pp., 7 figs. Washington, D.C., 1947.

Most of the information here given on the bionomics and control of *Cirphis unipuncta*, Haw., on cereals and grasses in the United States is the same as that in the original bulletin [*R.A.E.*, A **29** 300], but the findings of recent experiments on poison baits are included [**36** 96], and the application of arsenical dusts from aircraft is no longer recommended, since the heavy rates needed for effective control have caused serious cases of poisoning among farm animals.

CHERIAN (M. C.) & KYLASAM (M. S.). **Studies on the Spotted Bollworms of Cotton**—*Earias fabia* **S., and** *E. insulana* **B.**—*J. Bombay nat. Hist. Soc.* **46** no. 4 pp. 658–667, 5 refs. Bombay, 1947.

The authors give an account of the bionomics of *Earias fabia*, Stoll, and *E. insulana*, Boisd., in Coimbatore, South India, where cotton is sown in September or October and attack first becomes visible in November, when the affected top shoots show signs of withering. *E. fabia* is the predominant species, and *E. insulana* occurs sporadically. Observations showed that high larval populations tended to occur from the middle of December until early January and from the middle of May to July, and were accompanied by heavy shedding of buds and bolls. Infestation of green bolls was low in January and increased until the crop was pulled in April.

Both species were found breeding in capsules of *Abutilon indicum*, *A. hirtum*, *Malvastrum coromandelianum*, *Althaea rosea* and four species of *Hibiscus*. The larvae were present throughout the year. *H. vitifolius* was the more heavily infested by *E. fabia* and *Abutilon* by *E. insulana*. Larvae of both species were parasitised by *Bracon* (*Microbracon*) *lefroyi*, D. & G., on cotton and *H. esculentus* and by *B.* (*M.*) *greeni*, Ashm., on *H. vitifolius*, *A. hirtum* and *A. indicum*, and larvae of *E. fabia* were parasitised by *Agathis* (*Bassus*) sp. and *Actia hyalinata*, Mall., on cotton, *Rhogas aligarhensi*, Qadri, on cotton and *H. esculentus*, *Elasmus johnstoni*, Ferrière (which also parasitised the prepupae) on cotton and *H. vitifolius*, *Goryphus* (*Melcha*) *nursei*, Cam., and *Bracon* (*Microbracon*) *hebetor*, Say, on *H. esculentus*, and the Chloropid, *Polyodaspis compressiceps*, Duda, on *H. vitifolius*. The fact that *B. lefroyi* and *B. greeni* were not obtained from the same species of host food-plants and their disparity in size and colour suggest that they are distinct species [*cf. R.A.E.*, A **30** 583, etc.], and this view was confirmed by laboratory breeding tests, in which the parasites always bred true to type. The Eumenid, *Eumenes edwardsi*, Sauss., removed larvae of *E. fabia* to stock its nests, which are high up in trees.

The bionomics of the two species were similar, the egg, larval, prepupal and pupal stages lasting 2·5–3, 10–12, 1–1·5 and 7–10 days, respectively. Adults were found to live for up to 15 days and to deposit up to 385 eggs in twos and threes all over the plant. Females predominated slightly. The moths were not attracted to bright lights or the usual chemical attractants, but were slightly attracted to sesame oilcake when it was soaked in water and exposed in shallow trays in cotton fields.

PETTEY (F. W.). **The Biological Control of Prickly Pears in South Africa.**—*Sci. Bull. Dep. Agric. S. Afr.* no. 271, iv+163 pp., 3 col. pls., 31 figs., 1 col. fldg. map, 33 refs. Pretoria, 1948.

Of the 20 species of *Opuntia* known to have been introduced into South Africa, 19 now occur there as weeds. Their distribution and status are summarised in the introductory chapter of this bulletin. The two of outstanding importance are *O. megacantha* (*maxima*), which is the most widespread, and

O. aurantiaca, which is the most noxious. *O. tardiospina* (rondeblaar pear) [*R.A.E.*, A **30** 563] and *O. vulgaris* (*monacantha*) [**29** 17] are of less importance, *O. spinulifera* and *O. stricta* of only local significance, and the rest too rare to be troublesome. The bulk of the bulletin comprises a detailed account of the work done on the control of *O. megacantha* by the introduction of insects that feed on it, notably *Cactoblastis cactorum*, Berg, *Dactylopius opuntiae*, Ckll., and *Lagochirus funestus*, Thoms. It includes descriptions, varying in scope, of the insects and of some of their natural enemies, and accounts, often based on laboratory studies, of their bionomics, the methods adopted for rearing them in large quantities in the laboratory, their progress when liberated in the field, their present status [*cf.* **36** 171, etc.], and the factors operating on them in the field [**27** 459 ; **32** 34 ; **37** 265, 369 ; etc.], preceded by a description of the plant, a discussion of its economic importance as a weed, as food for human consumption and as fodder for livestock, and information on the acreage infested by it and the effect of climate on its distribution. It is thought that *D. opuntiae* can clear the Karroo and most inland areas that do not favour a resistant type of plant and in which the fungus of the genus *Empusa* [**36** 172], now tentatively determined as *E. lecanii*, does not limit its activity, within a few years, provided that both its rate of increase and its injuriousness are maintained and that plants weakened by attack are promptly felled [**32** 397]. *C. doddi*, Heinr., and *Moneilema ulkei*, Horn, the other two insects that were imported for trial against *O. megacantha* [**27** 459 ; **29** 18] did not thrive in the laboratory and were not liberated.

Similar information on *O. aurantiaca* and its control by the introduced species of *Dactylopius* near *confusus*, Ckll. [**28** 375] is given in a concluding chapter. This Coccid increased in numbers and gave good control from 1937 until about the end of 1942, by which time it had destroyed the aerial parts of the plants over extensive areas and was itself becoming less frequent. It did not become well established in certain areas where the plants were growing among bush and heavy undergrowth, however, and this was subsequently found to be due to its destruction by rodents. It is also attacked by *Exochomus flavipes*, Thnb., *Cryptolaemus montrouzieri*, Muls., the ant, *Anoplolepis steingroeveri*, Forel, and *Empusa* sp., any of which can prevent it from exerting effective control if present in considerable numbers. It may also be hindered by the presence of *C. cactorum*, which frequently oviposits on *O. aurantiaca*, though rarely controls it, and sometimes destroys segments already infested by the Coccid. In view of the severity with which the Coccid is attacked by natural enemies, its inability to destroy the underground " tubers ", and the long interval (at least five years) required for partially destroyed plants to make sufficient regrowth for it to become established again, the author considers the use, as a supplementary measure, of chemical and mechanical methods for the destruction of underground " tubers " and regrowth from partially destroyed plants to be essential.

Other species of *Opuntia* that are attacked, but not controlled, by *C. cactorum* include *O. vulgaris*, which is only lightly infested, and *O. spinulifera*, on which the larvae do not thrive [**28** 191] ; the moths also oviposit sometimes on *O. imbricata* and freely on *O. tardiospina*, but the larvae do not survive on them [*cf.* **30** 563].

SPEYER (E. R.), PARR (W. J.) & READ (W. H.). **Animal Pests.**—*32nd Rep. exp. Res. Sta. Cheshunt 1946* pp. 46–63, 2 pls., 4 graphs, 4 refs. Cheshunt, Herts., 1947.

This report of work on insect pests in glasshouses in Hertfordshire [*cf. R.A.E.*, A **36** 360] is composed of several sections, of which all those noticed below except the last are by Speyer & Parr.

In experiments with *Trialeurodes vaporariorum*, Westw., adults confined in large jars or in wide-mouthed bottles with or without moist cotton-wool, tomato leaves or tomato leaflets lived for maximum periods ranging from about two to ten days. It appeared that their life was prolonged a little by the presence of moisture and more by the food obtainable from young foliage but not from older leaves. Under natural conditions, the adults congregate round the growing point of the plant, and they may require a more or less continuous supply of nutriment that is not sufficiently plentiful in older leaves removed from the plant. Sprays containing 0·025 per cent. DDT as a suspension or emulsified solution applied on 21st June to severely infested tomato plants, 4 ft. in height, killed all the adults and many of the larvae, but the pupae were more resistant. The treated leaves remained toxic to emerging adults for about a week. A heavy infestation had again built up three weeks after treatment, augmented by adults entering from an adjoining house, and second applications of the suspension and emulsion, at concentrations giving 0·05 and 0·1 per cent. DDT, respectively, were made on 12th July. These also gave complete mortality of the adults, but did not prevent emergence from pupae ; the foliage remained toxic to the adults for at least 12 days. Some of the larvae were parasitised by *Encarsia formosa*, Gah., at the time of treatment, and the parasites failed to emerge, though they did so normally on leaves sprayed with water only. Tomato seedlings growing in pots and infested with eggs of *T. vaporariorum* were sprayed with the suspension and the emulsion at the increased concentrations when they were 5 ins. high. All the eggs on marked leaves hatched 3–6 days later. The young larvae appeared healthy, but most of those on leaves sprayed with the suspension were dead on the eighth day. By the 19th day after spraying, when the surviving larvae were in the third instar and some pupae were present, the average numbers per leaf were 1 for the suspension, 45 for the emulsion and 98 for the controls. Growing rhubarb among plants in glasshouses and frames has been reported to eliminate infestation by *T. vaporariorum*, but in a special test, rhubarb afforded no protection to tomatos. The rhubarb itself did not become infested, but the infestation on tomatos was as severe as in a house in which there was no rhubarb.

Larvae of *Diataraxia* (*Polia*) *oleracea*, L., were shown by Lloyd [**8** 518] to be usually unable to survive on an unvaried diet of tomato foliage of the variety Comet. In 1944, however, larvae reared in the laboratory during April and offered leaves of a newer variety (Potentate) and *Polygonum* (a preferred food-plant) fed almost exclusively on the former and pupated in 33–39 days. In an experiment in 1946, larvae in the first three instars collected from the variety Cooper's Ideal and others in the fourth, fifth and sixth instars from a number of varieties were each divided into two groups, of which one was fed on leaves of Potentate and the other on leaves of Comet. There was little difference in the rates of development or mortality, and it is concluded that changes in the conditions of cultivation may have altered the composition of tomato foliage, or, more probably, that a race of *D. oleracea* resistant to toxic substances in the foliage has arisen by gradual selection.

Small-scale experiments on the action of DDT on the cucumber-house woodlouse (*Armadillidium speyeri*, Jackson) were made in February–March. Mortality did not exceed about 50 per cent. when the woodlice were exposed to a 5 per cent. DDT dust for 30 minutes in a dish and later transferred to soil or when they were kept for a week in soil that had been thoroughly mixed with the dust at a rate of 1 : 100, but of 27 that were kept in soil the surface of which had been dusted with DDT, only seven were alive after a week. When baits of DDT or Paris green mixed with dry bran or dried blood in different proportions were scattered over the surface of soil in dishes and woodlice introduced, the standard bait of Paris green and dried blood (1 : 56) killed

24 out of 25 in a week. The best of the others was DDT in either carrier at the highest concentration tested (1 : 100), which killed 17–18 out of 24.

Further experiments were made on the effect of removing the cotyledons from tomato seedlings for the control of *Liriomyza strigata*, Mg. [**35** 328]. In a preliminary test made in May 1945, when temperatures were above normal, the cotyledons were removed 3–9 days after germination. The growth of both shoots and roots was retarded, and the leaves showed symptoms of phosphate deficiency for some weeks, although superphosphate was applied when the seedlings were potted up (11 days after germination) and, in some cases, again 12 days later. In a more extensive experiment in 1946, superphosphate was incorporated in the seed compost at the rate of one " 60 " size pot per barrow-load and in the potting compost at the same or three times the rate and the cotyledons were removed 4–14 days after germination. The reduction in increase of height and leaf-span was inversely proportional to the interval between germination and the removal of the cotyledons, and the addition of excess superphosphate at potting time partially restored the normal rate of growth. Adults of *L. strigata* begin to emerge from the soil soon after the glasshouses are heated for the propagation of tomato plants [*cf.* **35** 327]. Eggs are deposited within the cotyledons and hatch quickly, and the larvae may destroy the cotyledons within 11 days of germination. Although the larvae then attack the rough leaves, it is suggested that injury might be reduced by the incorporation of extra amounts of mineral fertiliser, especially superphosphate, in the potting compost.

In preliminary work on the effect on *Tetranychus telarius*, L., of azobenzene delivered as an aerosol from a spray gun, on which further information is given by Read, a solution of 16 gm. azobenzene in 112 cc. acetone was released in a glasshouse of 2,000 cu. ft. capacity containing infested carnations on 17th October. After three hours, during which the temperature was 62–66°F. and the relative humidity 80–90 per cent., the mites were incapable of co-ordinated movement and large numbers of adults and young were found hanging from the leaves by threads. Of 11 adults and eight immature mites kept under observation on a treated carnation leaf and 15 females and six immature mites that were transferred to a fresh tomato leaf, most appeared to have recovered after 18 hours, but of the former, only two females, almost incapable of movement, were alive after four days, and of the latter, only two females that had assumed the red coloration characteristic of hibernating mites survived for eight days, and these died on the ninth. Many of the mites on infested leaves collected 24 hours after treatment were still active on the following day, but only one female, which deposited a few eggs, survived until the seventh day. On that day, however, large numbers of active females were found in the glasshouse on a blade of grass (*Oryza*) growing vertically in a pot ; they had evidently climbed on to it after falling from the carnations and bred prolifically on it, though a week later no mites were alive on the carnations. Acetone vapour had only a transitory anaesthetic effect on the mites, even when present in relatively high concentrations. Laboratory experiments in late October, in which hibernating mites in small tubes were exposed to azobenzene in various ways at a temperature of 60–75°F., indicated that rapid diffusion of the vapour caused the mites to become greatly agitated and to spin webbing, but a more or less gradual diffusion had no irritant effect, and the mites died after a comparatively long time, possibly following condensation of azobenzene on the cuticle and its gradual penetration into the internal organs. Mites in contact with solid or semi-solid azobenzene did not react immediately, but died or became moribund after some time ; there may have been some adsorption on the cuticle and slow penetration. Deeply staining rounded or oval bodies of various sizes were found in the cells lining the combined hind-gut and excretory organ, most of which lies close below the dorsal cuticle, in mites exposed to azobenzene, but such bodies also occur in untreated mites, and probably mark the first phase of general disorganisation of the tissues prior to death from any cause.

Read states that when azobenzene is applied in acetone as an aerosol, the particles vaporise rapidly. A standard paint spray gun operated by compressed air was used, the air pressure being 45 lb. per sq. in. and the rate of discharge usually 3 fl. oz. per minute. When the azobenzene was applied in tomato houses, the plants were damaged by direct contact with the mist from the gun, and it was necessary to adjust the rate of discharge to avoid injury ; a higher rate could be used for carnations, since the spray could be discharged above them. Acetone solutions containing 12·5 or 20 per cent. w/v azobenzene discharged at a rate of 0·3 oz. azobenzene per 1,000 cu. ft. did not damage tomatos or carnations, even at temperatures as low as 59–61°F., and killed 83–100 per cent. of adults of *T. telarius* in a week. Similar results were obtained when azobenzene crystals were volatilised over a spirit lamp in a house of 1,500 cu. ft. capacity containing tomato plants in one half and infested tomato and carnation plants in pots in the other ; vaporisation occupied 2–3 hours, and fumigation was continued for six hours or throughout the night. The temperature could not be regulated, and the period for which the mites survived appeared to be greater at low temperatures than at high and was five days at 60°F. Mortality was not due to the presence of azobenzene or some other toxic substance on the leaves, since mites transferred after fumigation to untreated leaves all died in five days. The plants were not damaged by 0·6 oz. azobenzene per 1,000 cu. ft., when the temperature rose to an average of 88°F. for four hours during exposure, but tomato plants were severely damaged and carnation flowers injured when it fell from 70 to 65°F. during the first two hours. In both these tests, complete mortality of adult mites was obtained in a week, and no living stages were found on the plants after a fortnight. Azobenzene at 0·3 oz. gave 78–100 per cent. mortality of adults and caused no damage when temperatures remained above 70°F. during exposure, but when the temperature fell rapidly from 76 to 63°F. soon after the start tomatos in one corner of the house were damaged. A rate of 0·25 oz. azobenzene per 1,000 cu. ft. did not give complete mortality. When the azobenzene was vaporised quickly on an electric hot plate, rates as low as 0·18 oz. per 1,000 cu. ft. damaged the upper leaves of tomatos near the apparatus, probably owing to local high concentrations of vapour. It is pointed out that vaporising lamps in tomato houses must of necessity be near the plants, and that unless considerable numbers are used, the rate of vaporisation from individual lamps must be high in order to obtain the necessary vapour concentration.

PAPERS NOTICED BY TITLE ONLY.

CARTER (R. H.). **Report on Methods for Determination of DDT in Insecticide Residues and in Animal Products.**—*J. Ass. off. agric. Chem.* **30** no. 3 pp. 456–463, 27 refs. Washington, D.C., 1947.

CARTER (R. H.). **Estimation of DDT in Milk by Determination of organic Chlorine.**—*Industr. Engng Chem.* Anal. Edn. **19** p. 54, 3 refs. Easton, Pa., 1947. [*Cf. R.A.E.*, A **38** 382.]

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